Proceedings of the 2004 National Beaches Conference

October 13-15, 2004

Proceedings of the 2004 National Beaches Conference

March 2005

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Introduction

The goal of the U.S. Environmental Protection Agency's Beaches Environmental Assessment, Closure and Health (BEACH) Program is to work in partnership with states, tribes, territories, local governments, and the public to significantly reduce the risk of disease to users of the nation's recreational waters. This is accomplished through improvements in recreational water programs, communication, and scientific advances. BEACH Act grants are awarded to eligible coastal and Great Lakes states, territories, and tribes to develop and implement beach monitoring and notification programs.

On April 20, 2004, EPA announced the Administration's Clean Beaches strategy. The strategy includes the Clean Beaches Plan. By carrying out the Clean Beaches Plan, EPA is helping state, tribal, and local beach managers strengthen their programs. A strategy for reducing the risks of infection to people who use the nation's recreational waters, the plan recognizes that beach managers need tools that allow for local and regional differences in pollution sources and climate. The Clean Beaches Plan describes what EPA plans to do over the next couple of years to achieve two major goals: promote recreational water quality programs nationwide and create scientific improvements that support timely recreational water monitoring and reporting.

The national conference was organized as part of the Clean Beaches Plan. It provided a forum for learning about beach health initiatives across the country; presenting new methods, indicators, and modeling techniques; identifying beach health needs; discussing priorities for short-term and long-term actions; and recommending protocols and procedures to encourage greater consistency among jurisdictions. The conference was organized into the following sessions:

- Session One: Welcome and Plenary Speakers
- Session Two: State and Local Experiences in Implementing Beach Monitoring and Notification Programs
- Session Three: Design of Beach Monitoring Programs
- Session Four: The Public Notice Decision Process and Public Perception
- Session Five: Source Identification
- Session Six: Total Maximum Daily Loads
- Session Seven: Remediation Approaches
- Session Eight: Making Warning Systems More Rapid: Modeling and Rapid Methods
- Session Nine: New Health Risk Indicators
- Session Ten: Quantifying Swimmer Risk
- Session Eleven: Plenary Panel Discussion
- Session Twelve: Data Management and Communication
- Session Thirteen: Communicating Beach Condition to the Public
- Session Fourteen: Conference Wrap-Up

Each session consisted of individual presentations and a discussion period with questions and comments from the audience and responses by the speakers. This proceedings document contains each speaker's presentation slides, summaries of audience questions and responses, and a summary of the plenary panel discussion.

Acknowledgments

The Office of Science and Technology (OST) in the U.S. Environmental Protection Agency's Office of Water funded the 2004 National Beach Conference. The Standards and Health Protection Division in OST organized the conference and Tetra Tech, Inc. provided support for the conference and this proceedings document under EPA contract C-04-030.

The planning workgroup included the following representatives:

- EPA Headquarters: Beth LeaMond, Bryan "Ibrahim" Goodwin, Charles Kovatch, Rick Hoffmann, Jim Pendergast, Wendy Miller, and Denise Keehner
- EPA Regional and Research Offices: Matt Liebman, Joel Hansel, Al Dufour, Holly Wirick, Mike Schaub, Terry Fleming, and Janet Hashimoto
- State and local Beach Program or public health officials: Shannon Briggs, Blake Traudt, Don Killinger, Sara Sumner, Bob Vincent, Lynn Schneider, Toni Glymph, Esperanza Stancioff, Eric Sacon, Jody Connor, Paul Whelan, and Dave Burnett
- The California State Water Resources Control Board: Robin McCraw
- Tetra Tech: Shannon Prendergast and Melissa Canfield
- The Southern California Coastal Water Research Project: Steve Weisberg

Contributions of those who helped in the planning and organizing of this successful conference is greatly appreciated. Special thanks is extended to EPA Region 9 for helping to plan the conference and to the State Water Resources Control Board of the State of California for their contributions to the program and for welcoming us to their home territory. Steve Weisberg from the Southern California Coastal Water Research Project contributed much time and energy in developing the program, contacting people, and in helping with logistics. The contributions of the invited speakers and attendees are gratefully acknowledged. Their efforts were critical to the success of the conference.

The material in this document has been subjected to Agency technical and policy review and approved for publication as an EPA report. The views expressed by individual authors, however, are their own and do not necessarily reflect those of EPA. Mention of trade names, products, or services does not convey, and should not be interpreted as conveying, official EPA approval, endorsement, or recommendation.

Contents

National Beaches Conference

DAY TWO

National Beaches Conference Agenda

October 13-15, 2004
San Diego, California

Tuesday, October 12, 2004

5:00–7:00 **Early Bird Registration**
Hotel Lobby

Wednesday, October 13, 2004

7:30–5:00 **Registration**
Grand Ballroom Lobby

8:00 **Registration**
Grand Ballroom Lobby

8:30–9:50 **Session I: Welcome & Plenary Speakers**
Moderator—Beth LeaMond,
U.S. Environmental Protection Agency
Salon D&E

8:30–8:45 **San Diego Welcome**
Donna Frye, City Councilmember,
City of San Diego

8:45–9:00 **EPA Welcome**
Wayne Nastri,
U.S. Environmental Protection Agency

9:00–9:25 **Plenary Speaker—Beach Act Actions: 2000–2004 and Beyond**
Denise Keehner,
U.S. Environmental Protection Agency,
Office of Science and Technology

9:25–9:50 **Plenary Speaker—Waterborne Pathogens and Indicators: A Pathway Forward**
Joan Rose, Michigan State University

9:50–10:20 **Break**

10:20–12:00 **Session II: State and Local Experiences In Implementing Beach Monitoring & Notification Programs**
Moderator - Janet Hashimoto,
U.S. Environmental Protection Agency
Salon D&E

10:20–10:40 **Hawaii Watershed Initiative and Clean Beaches**
Carl Berg, Hanalei Watershed Hui

10:40–11:00 **Florida's Healthy Beaches Monitoring Program**
Bart Bibler,
Florida Department of Health

11:00–11:20 **Surf and Turf: Developing Partnerships for Maine's Beaches**
Esperanza Stancioff,
University of Maine Cooperative
Extension/ Sea Grant

11:20–11:40 **Incorporating the Bacterial Indicator Enterococci in Marine Beach Water Quality Monitoring Programs**
Clay Clifton, County of San Diego

11:40–12:00 **Washington State's Beach Environmental Assessment, Communication, and Health {BEACH} Program**
Lynn Schneider,
Washington State Department of Ecology

12:00–1:20 **Lunch**

1:20–2:50 **Session III: Design of Beach Monitoring Programs**
Moderator—Matthew Liebman, U.S.
Environmental Protection Agency
Salon D&E

1:20–1:30 **EPA Overview: Current National Requirements, Guidance And Hot Issues**
Matthew Liebman, U.S. Environmental
Protection Agency

1:30–1:50 **Public Health Protection at Marine Beaches: A Model Program for Water Quality Monitoring and Public Notification**
Mitzy Taggart, Heal the Bay

1:50–2:10 **Comparison And Verification Of Bacterial Water Quality Indicator Measurement Methods Using Ambient Coastal Water Samples**
John Griffith, Southern California Coastal Water Research Project

2:10–2:30 **Composite Sampling as an Alternative Technique for the Determination of Bacterial Indicators in Recreational Waters**
Julie Kinzelman, City of Racine

2:30–2:50 **How Often and Where To Monitor: Outcome Of The EMPACT Study**
Larry Wymer, U.S. Environmental Protection Agency

2:50–3:20 **Break**

3:20–5:00 **Session IV: The Public Notice Decision Process and Public Perception**
Moderator—Robin McCraw,
California State Water Resources Control Board
Salon D&E

3:20–3:40 **Source Unknown: Questionable Geometric Mean Exceedances at Two Pristine North Carolina Beaches**
J.D. Potts, North Carolina Department of Environment and Natural Resources

3:40–4:00 **Misinformation in Beach Warning Systems**
Stanley Grant,
University of California at Irvine

4:00–4:20 **The Cost of Beach Water Monitoring Errors in Southern California**
Linwood Pendleton, University of California at Los Angeles

4:20–4:40 **Communication: Increasing Public Awareness about Beaches**
Harry Simmons, American Shore and Beach Preservation Association

4:40 - 5:00 **City of Encinitas Perspective on Beach Postings**
Katherine Weldon, City of Encinitas

6:00–8:00 **Poster Session**
Sponsored by American Shore & Beach Preservation Association
Ballroom Foyer & Sierra 5/6

Conference participants are invited to convene for light refreshments and discussion. Over thirty displays prepared by scientists and industry experts will be presented. Light refreshments and a cash bar will be available.

Thursday, October 14, 2004

Concurrent Track I: Identifying and Solving Beach Water Quality Problems

7:30–5:00 **Registration**
Grand Ballroom Lobby

8:00 **Registration**
Grand Ballroom Lobby

8:00–9:40 **Session V: Source Identification**
Moderator—Don Killenger, Cuyahoga County Board of Health
Salon A/B/C

8:00–8:20 **EPA Guidance Manual on Source Identification**
Gerard Stelma, U.S. Environmental Protection Agency

8:20–8:40 **Tiered Approach for Identification of a Human Fecal Pollution Source at a Recreational Beach: Case Study at Avalon Bay, Catalina Island, California**
Alexandria Boehm, Stanford University

8:40–9:00 **Fecal Source Identification with Bacteroidetes Molecular Markers**
Katharine Field, Oregon State University

9:00–9:20 **Using Microbial Source Tracking in New Hampshire: Applications, Results and Challenges**
Stephen Jones, University of New Hampshire

9:20–9:40 **Replication of *E. coli* in Sand at a Temperate Freshwater Beach**
Elizabeth Alm, Central Michigan University

9:40–10:20 **Break**

10:20–12:00 **Session VI: TMDLs**
Moderator—Joel Hansel, U.S. Environmental Protection Agency
Salon A/B/C

10:20–10:40 **A Watershed Scale Approach for Developing a Bacterial TMDL in an Urbanizing Puget Sound Embayment**
Christopher May, Battelle Marine Science Laboratory

10:40–11:00 **Improving Beach Water Quality through TMDLs: A Case Study of Santa Monica Bay Beaches**
Renee DeShazo, Los Angeles Regional Water Quality Control Board

11:00–11:20 **Delisting of Recreational Beaches on the 303(d) List for Exceedances of Bacterial Water Quality Standards**
Lisa Kay, MEC-Weston Solutions, Inc.

11:20–11:40 **"The Hunt for Red *E. coli*"–Bacteria Source Tracking in Lake Darling Watershed**
Eric O'Brien, Iowa Department of Natural Resources

11:40–12:00 **San Diego Creek Watershed Natural Treatment System**
Norris Brandt, Irvine Ranch Water District

12:00–1:20 **Lunch**
Pavillion

Linking the Oceans and Human Health: Perspectives from the U.S. Commission on Ocean Policy and the new NOAA OHH Initiative
Paul Sandifer, National Oceanic and Atmospheric Administration
Sponsored by Idexx Laboratories

1:20–3:00 **Session VII: Remediation Approaches**
Moderator—Holly Wirick, U.S. Environmental Protection Agency
Salon A/B/C

1:20–1:40 **California's Clean Beach Initiative**
Mark Gold, Heal the Bay

1:40–2:00 **EPA's Clean New England Beaches Initiative and Flagship Beaches**
Matthew Liebman, U.S. Environmental Protection Agency

2:00–2:20 **The Effectiveness of Spatial Distribution Studies in the Development of Successful, Cost-Effective, Targeted Remediation Efforts**
Julie Kinzelman, City of Racine

2:20–2:40 **Utilizing Storm Water Monitoring To Assess Beach Water Quality**
Jill Lis, Cuyahoga County Board of Health

2:40–3:00 **Diversion is the Solution to Pollution, So Far**
Cathy Chang, Santa Monica Bay Restoration Commission

3:00–3:20 **Break**

3:20–5:00 **Session XI: Plenary Panel Discussion**
Moderator—Steve Weisberg, Southern California Coastal Water Research Project
Salon D/E

Panel
- Denise Keehner, U.S. Environmental Protection Agency
- Shannon Briggs, Michigan Department of Environmental Quality
- Rachel Noble, University of North Carolina at Chapel Hill
- Mark Gold, Heal the Bay
- Monica Mazur, Orange County Environmental Health

Thursday, October 14, 2004

Concurrent Track II: Changes on the Horizon

7:30–5:00 **Registration**
Grand Ballroom Lobby

8:00 **Registration**
Grand Ballroom Lobby

8:00–9:40 **Session VIII: Making Warning Systems More Rapid: Modeling and Rapid Methods**
Moderator—Steve Weisberg, Southern California Coastal Water Research Project
Salon D/E

8:00–8:20 **A Regional Nowcast Model for Southern Lake Michigan Using Data Readily Available to Beach Managers**
Richard Whitman, U.S. Geological Survey

8:20–8:40 **Predicting the Need for Beach Closures in Real Time: Statistical Approaches and their Applicability to the Lake Michigan Shoreline**
Greg Olyphant, Indiana University

8:40–9:00 **High Frequency Radar Provides Real Time Data for Enhancing Beach Monitoring Programs**
Eric Terrill, Scripps Institution of Oceanography

9:00–9:20 **Rapid Measurement of Bacterial Fecal Pollution Indicators at Recreational Beaches by Quantitative Polymerase Chain Reaction**
Richard Haugland, U.S. Environmental Protection Agency

9:20–9:40 **Recreational Water Testing by Rapid, High-Throughput Real Time Quantitative PCR (QPCR) for Fecal Indicators**
Jack Paar and Mark Doolittle, U.S. Environmental Protection Agency

9:40–10:20 **Break**

10:20–12:00 **Session IX: New Health Risk Indicators**
Moderator—Rebecca Calderon, U.S. Environmental Protection Agency
Salon D/E

10:20–10:40 **Comparative Testing of Rapid Microbiological Indicator Methods for Marine Recreational Water Monitoring**
Stephen Weisberg, Southern California Coastal Water Research Project

10:40–11:00 **Assay and Remote Sensor Development for Molecular Biological Water Quality Monitoring**
Kelly Goodwin, National Oceanic and Atmospheric Administration (NOAA)

11:00–11:20 **Quantification of Enterovirus in Seawater at Imperial Beach, CA using real-time RT-PCR**
Rick Gersberg, San Diego State University, School of Public Health

11:20–11:40 **Rapid Detection of Enteroviruses in Environmental Samples using Real-time Quantitative Reverse Transcriptase PCR**
Rachel Noble, University of North Carolina at Chapel Hill

11:40–12:00 **Male-Specific Coliphages as Indicators of Fecal Pollution in Coastal Recreational Waters**
Greg Lovelace, University of North Carolina at Chapel Hill

12:00–1:20 **Lunch**
Pavillion

Linking the Oceans and Human Health: Perspectives from the U.S. Commission on Ocean Policy and the new NOAA OHH Initiative
Paul Sandifer, National Oceanic and Atmospheric Administration
Sponsored by Idexx Laboratories

1:20–3:00 **Session X: Quantifying Swimmer Risk**
Moderator—Al Dufour, U.S. Environmental Protection Agency
Salon D/E

1:20–1:40 **EPA national Epidemiology Study**
Timothy Wade, U.S. Environmental Protection Agency

1:40–2:00 **Mission Bay Epidemiology Study**
Jack Colford, University of California at Berkeley

2:00–2:20 **Risk Perception Bias and Self Reported Symptoms**
Jay Fleischer, NOVA Southern University

2:20–2:40 **Criteria Development: Beach Act Requirements and Schedule**
Stephen Schaub, U.S. Environmental Protection Agency

2:40–3:00 **Evaluation of Recreational Health Risk in Coastal Waters Based on Enterococcus Densities and Bathing Patterns**
David Turbow, Touro University International

3:00–3:20 **Break**

3:20–5:00 **Session XI: Plenary Panel Discussion**
Moderator—Steve Weisberg, Southern California Coastal Water Research Project
Salon D/E

Panel

- Denise Keehner, U.S. Environmental Protection Agency
- Shannon Briggs, Michigan Department of Environmental Quality
- Rachel Noble, University of North Carolina at Chapel Hill
- Mark Gold, Heal the Bay
- Monica Mazur, Orange County Environmental Health

Friday, October 15, 2004

7:30–12:00 **Registration**
Grand Ballroom Lobby

8:00 **Registration**
Grand Ballroom Lobby

8:10–9:50 **Session XII: Data Management and Communication**
Moderator–Charles Kovatch, U.S. Environmental Protection Agency
Salon D/E

8:10–8:30 **eBeaches**
Charles Kovatch, U.S. Environmental Protection Agency

8:30–8:50 **Managing, Storing and Sharing Beach Monitoring Data**
Bill Geake, Windsor Solutions

8:50–9:10 **Leveraging Technology for Effective Beach Management**
Eric Sacon, Rhode Island Department of Health

9:10–9:30 **Experience of Delaware**
Dennis Murphy, Delaware Department of Natural Resources & Environmental Control

9:30–9:50 **Experience of Massachusetts**
Tom Hinchliffe, Massachusetts Department of Public Health

9:50–10:20 **Break**

10:20–11:40 **Session XIII: Communicating Beach Condition to the Public**
Moderator: Toni Glymph, Wisconsin Department of Natural Resources
Salon D/E

10:20–10:40 **Heal the Bay's Beach Report Card®: Communicating Complex Water Quality Issues and Improving Public Health**
James Alamillo, Heal the Bay

10:40–11:00 **Methods for Assessing Beach Management Policy Effectiveness**
Sharyl Rabinovici, U.S. Geological Survey

11:00–11:20 **Beachwater Contamination and Source Control: the Public Right-to-Know**
Mark Dorfman, Environmental Research and Education

11:20–11:40 **So Many Report Cards, So Little Information**
Steve Aceti, California Coastal Coalition

11:40–12:00 **Session XIV: Conference Wrap Up**
Salon D/E
Workshop Summary and Future directions of the EPA BEACH Program
Denise Keehner, U.S. Environmental Protection Agency, Office of Science and Technology

Wednesday, October 13

8:30 a.m. – 9:50 a.m.

Session One: Welcome and Plenary Speakers

San Diego Welcome

Donna Frye
City of San Diego

Biosketch

Donna Frye was elected Councilmember for the City of San Diego's Sixth District in a special election on June 5, 2001. She was re-elected to a full, four-year term in March 2002 with a resounding 65 percent of the vote. Councilmember Frye currently serves as the Vice Chair of the Public Safety and Neighborhood Services Committee. She also serves on the Natural Resources and Culture Committee, Land Use and Housing Committee, Mayor Murphy's Clean Water Task Force, San Diego River Conservancy, Abandoned Vehicle Abatement Service Authority, Local Agency Formation Commission, SANDAG Walkable Communities Committee, San Diego Trolley Advisory Board and the Service Authority for Freeway Emergencies.

Councilmember Frye is an environmental activist who has advocated for more open decision-making by elected officials. She is the founder of Surfers Tired of Pollution (STOP), an advocacy group created in 1995 to protect natural resources, and is a past consultant for the Center for Marine Conservation, a national nonprofit group based in Washington D.C. Donna also co-owns a surf shop in Bay Park with her husband, legendary surfer, Harry "Skip" Frye.

As a Councilmember, Donna has worked tirelessly to increase public participation in local government, ensure that city resources are allocated to the communities of District Six, repair and replace aging infrastructure, ensure that development in District Six complies with Community Plans, expand Branch Library services, expedite undergrounding of utilities, protect and preserve our canyons, open space and public parkland, reduce sewage spills and prevent polluted runoff, and slow down traffic in our neighborhoods.

Before being elected, Councilmember Frye was active in community and environmental issues in San Diego since the early 1980s. Donna advocated for clean water issues and openness and ethics in government. She worked to strengthen San Diego City policies related to polluted runoff, including the initiation of the posting of warning signs in front of storm drains, the monitoring of discharges at storm drain outfalls, the diversion of dry weather low-flow runoff into the sewer system and she played a central role in obtaining millions of dollars for the clean up of Mission Bay.

Councilmember Frye is a member of the Clairemont Town Council, Linda Vista Civic Association, and Women In Business, and was a long-time member and former Vice Chair of the Pacific Beach Community Planning Committee. To ensure that small business owners had the right to vote when their taxes were increased for Business Improvement Districts, Donna worked jointly with the San Diego Taxpayers' Association and the Howard Jarvis Taxpayers' Association.

In recognition of her hard work on behalf of our communities, Donna has received commendations from the San Diego County Board of Supervisors and Assembly Member Howard Wayne. She also received the Bank of America Small Business Award for Commitment to Community and was named Environmentalist of the Year by the Surf Industry Manufacturers Association (SIMA). Washington D.C. based, Clean Water Network named Donna one of thirty national Clean Water Act heroes for her contribution to the protection and restoration the nation's rivers, lakes, wetlands and coastal waters.

EPA Welcome

Wayne Nastri
U.S. Environmental Protection Agency, Region 9

Biosketch

Wayne Nastri, a lifelong westerner, was appointed Regional Administrator for Region 9 in October 2001. Mr. Nastri has led the Region to real progress in meeting the west's environmental challenges, especially in improving air quality in the Central Valley and Southern California and in protecting of scarce water resources throughout the arid west. Clear communication, strong enforcement and accountability to the public for a measurable "bottom line" have been the hallmarks of his tenure. A strong proponent of partnership as the best route to environmental protection, Mr. Nastri has launched many creative collaborations to protect the health and environment of all those who live in the Pacific Southwest.

Most recently, Mr. Nastri partnered with EPA's Seattle region to launch the West Coast Diesel Emission Reduction Collaborative, which will speed voluntary reductions of diesel emissions from ports, trucks and other federally regulated sources in a significant assault on one of the west's gravest air quality problems. Mr. Nastri also created EPA's Southern California Field Office in Los Angeles -- a major improvement in EPA's local presence for the region's largest metropolitan area.

Prior to his appointment, Mr. Nastri held various environmental leadership positions, including Board membership for California's South Coast Air Quality Management District (covering Southern California), as well as participation in advisory boards for California's state air quality and waste management agencies. His fifteen years of environmental consulting experience culminated in his presidency of Environmental Mediation Inc. before accepting his position at EPA.

Beach Act Actions: 2000-2004 and Beyond

Denise Keehner
U.S. Environmental Protection Agency, Office of Science and Technology

Biosketch

Denise Keehner is the Director of the Standards and Health Protection Division in the Office of Science and Technology in the Office of Water. Her Division is the Headquarters Office responsible for the Water Quality Standards Program, the Beach Program, and, the Fish Advisory Program. Denise has been in this position since May 2003. Prior to her joining the Office of Water, Denise was the Director of the Biological and Economic Analysis Division (BEAD) in the Office of Pesticide Programs (OPP) and the acting Director of the Environmental Fate and Effects Division in OPP. She has been with USEPA at Headquarters for 26 years and has served in management positions since 1985.

Partnering for Clean Beaches

Taking Stock and Turning to the Future

Denise Keehner
U.S. Environmental Protection Agency

National Beach Conference
10/13/04

We have a dream.....

- Imagine a time in the future when people don't have to wonder about whether swimming is safe at any beach in the country because:
  - pollution sources are controlled such that they do not impact beaches
  - you know that the water is sufficiently tested
  - the public is promptly notified in real time when there is a real problem

Overview of Conference Goals

- **Conference is a good chance to:**
  - Look at what we have accomplished
  - Develop a shared vision of where we want to go in the future
  - Identify key sets of priorities for federal, state, and local actions.

Environmental Concerns

- BEACH Act passed in response to key concerns:
  - Persistent beach advisories and closings
  - Substantial inconsistency in beach monitoring
  - Inconsistent public notification programs
  - Divergent water quality standards
  - Increased development pressure

Beach Act Progress

- Where are we?
  - Making good progress with substantial effort in following areas:
    - Water quality criteria and standards
    - Grants to support and strengthen state, territorial, and local programs
    - Monitoring
    - Public notification
    - Data systems development
    - Research

Water Quality Criteria & Standards

- Existing Criteria & Standards
  - **BA Provision:** State must adopt EPA's recommended water quality criteria (or criteria as protective) within 3 ½ years [4/04]. If state fails to adopt, EPA shall propose regulations for revised standard
  - EPA's rule has consumed much of my office's time in recent months.
  - ***"Heads Up"***
    - Rule to be finalized soon putting 304(a) criteria in place wherever they aren't (coastal and Great Lakes); maybe as soon as this week

Water Quality Criteria & Standards

- **New/Revised Criteria**
  - **BA Provision:** EPA shall conduct research for new indicators & propose new criteria within five years [10/05]
  - ***Status:*** This topic will be discussed later in the program.
    - Multi-million dollar effort by EPA's Office of Research and Development. Collaborative effort between two labs (NERL and NHEERL).
      - Monitoring and epi studies; criteria dev.
  - ***"Heads Up"***
    - **Intensive Technical Review and significant decisions** – Many upcoming reviews during next year that will affect states in the future.

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BEACH Grants

- Grants
  - ***B A Provision:*** Act adds new Section 406 to Clean Water Act which authorizes federal grants to conduct monitoring and notification programs.
  - ***Status:*** $32 million since FY 2001.
    - States have used grants to strengthen equipment, staff, and beach programs
  - ***"Heads Up":***
    - Beach Act reauthorization coming, therefore, scrutiny of beach programs. Be sure that
      - grant applications & approvals are timely & expenditure are prompt and meet requirements
      - programs are well established and performing well

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Beaches & Monitoring

- National "List of Beaches" and Locations
  - States submitted their *List of Beaches* to EPA during fall 2003 and spring, 2004.
  - EPA published the List of Beaches in the Federal Register on May 4, 2004. We have on the order of 6,000 beaches now listed with 57% reportedly monitored
  - List will be updated periodically

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Beaches & Monitoring

- **Monitoring accomplishments**
  - EPA guidance recommended risk-based, tiered monitoring
  - ORD intensive monitoring study undertaken
  - State revisions to improve, clarify, and/& expand monitoring. Better information on beach locations, monitoring stations and monitoring programs. Some increased monitoring apparent.
  - ***"Heads Up":***
    - ORD and other recent monitoring studies raise issues about needed frequency and location of monitoring. Monitoring programs will face difficult choices about how to balance the need for more robust data with funding limitations.

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Public Notification & Communication

- Public Notification
  - ***Status:*** Goal is to inform public so they can make informed decisions before going to the beach, reducing illness risk.
  - Public notification efforts improving
  - Emergence of reports from groups like Heal the Bay, Surfrider, Earth 911.
- ***"Heads Up":***
  - Be sensitive to information the public wants and how they interpret it. Some needs are "real time" whereas other information needs to be synthesized over multiple years for, say, vacation planning purposes.

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Beach Data

- National Beach and EPA data
  - ***BA Provision:*** EPA provide national database monitoring and notification submitted by states & locals.
  - ***Status:*** Major effort by EPA and states.
    - "eBeaches" multiple databases to collect, store, display beach water quality data, beach advisory data, and beach location data.
  - ***"Heads Up":***
    - Need for prompt, complete and accurate beach-related information by the public, government managers, strategic planners, and others.
    - Change is constant in the Information Technology realm.

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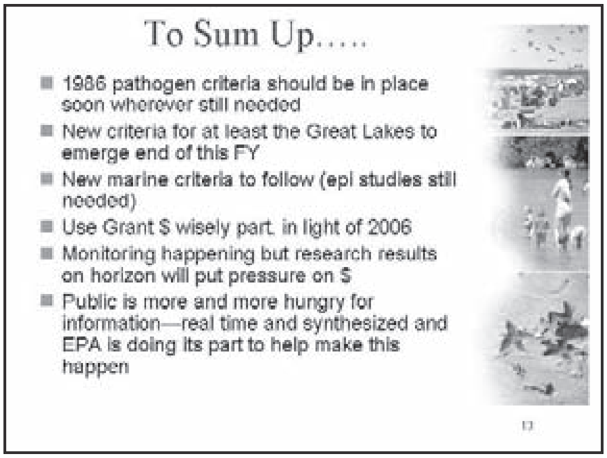
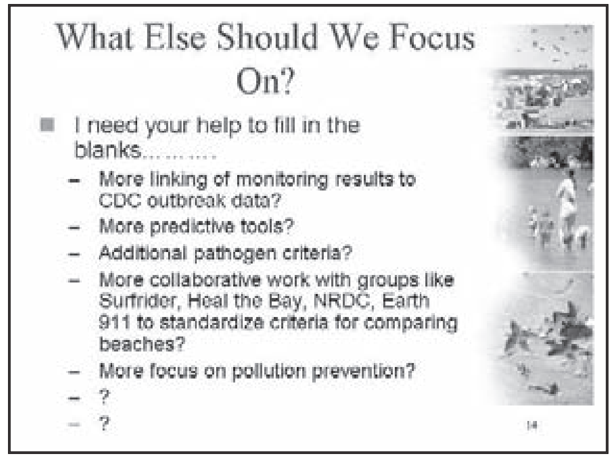

To Sum Up…..
1986 pathogen criteria should be in place soon wherever still needed
New criteria for at least the Great Lakes to emerge end of this FY
New marine criteria to follow (epi studies still needed)
Use Grant $ wisely part. in light of 2006
Monitoring happening but research results on horizon will put pressure on $
Public is more and more hungry for information—real time and synthesized and EPA is doing its part to help make this happen
13


What Else Should We Focus On?
I need your help to fill in the blanks……….
– More linking of monitoring results to CDC outbreak data?
– More predictive tools?
– Additional pathogen criteria?
– More collaborative work with groups like Surfrider, Heal the Bay, NRDC, Earth 911 to standardize criteria for comparing beaches?
– More focus on pollution prevention?
– ?
– ?
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Waterborne Pathogens and Indicators: A Pathway Forward

Joan Rose
Michigan State University

Biosketch

Dr. Joan B. Rose currently holds the Homer Nowlin Chair in Water Research at Michigan State University after receiving her PhD from the University of Arizona and spending 14 years at the University of South Florida. Dr. Rose is an international expert in water microbiology, water quality and public health safety publishing more than 200 manuscripts. Her work has examined new molecular methods for waterborne pathogens and zoonotic agents such as *Cryptosporidium* and enteric viruses and source tracking techniques. She has been involved in the study of water supplies, water used for food production, and coastal environments as well as water treatment wastewater treatment, reclaimed water and water reuse and quantitative microbial risk assessment. She specifically interested in microbial pathogen transport in coastal systems and has studied the impact of wastewater discharges and climate on water quality. She has recently been appointed to the Science Advisory Board for the International Joint Commission of the Great Lakes and the Drinking Water Committee for the Environmental Protection Agency. She was awarded the 2001 Clarke Water Prize. She is serving as the Chair of the International Water Association's Health-Related Water Microbiology Specialty Group.

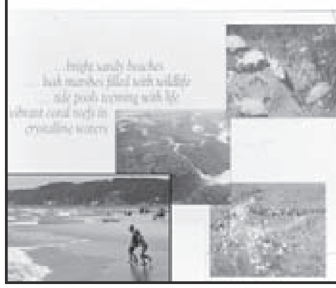
Waterborne Pathogens and Indicators: A Pathway Forward

Joan B. Rose

MICHIGAN STATE UNIVERSITY

Indicators for Waterborne Pathogens

NRC report 2004



- Evaluate strengths and weaknesses of Indicators.
- Identify which can address sources.
- Define current waterborne pathogens and emerging pathogens.
- Report on Future indicators and methods.
- Address practicality of technology.
- Examine research and data needs for validation of methods

Three-level Phased Monitoring Approach

Level A Screening/ Routine monitoring

Level B Investigations to confirm health risk

Level C Detailed Investigations: Source Transport Mitigation

Indicators Screening Level A

	numbers of Jurisdictions 2002
Fecal coliforms	36 for Fresh; 14 for Marine waters
E.coli	11 for Fresh; 0 for Marine waters
Enterococci	2 for Fresh; 7 for Marine waters

Current and Alternative Indicators

Indicator Standards for Recreational and Marine Water

Fecal coliforms	200 cfu/100mL Ave density
E.coli	126 cfu/100mL Ave density
Enterococci	33 to 35 cfu/100ml Ave density
Clostridium perfringens	50 or 5 cfu/100ml (Fujioka et al 1985)
Coliphage	No current suggested standards 100 pfu relates to enteric virus presence

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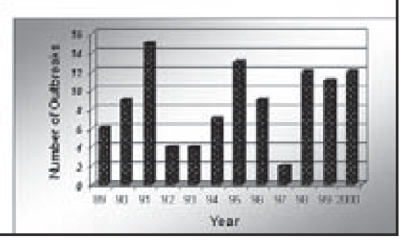
Recreational Outbreaks in Ambient Waters

Indicators relationship:

- to health effects
- to pathogen occurrence
- To sources



Correlations of Indicators in a Marine coastal system

Indicators against each other:	r value
E.coli/FC	0.968
Coliphage/Enterococci	0.781
Enterococci/FC	0.650
E.coli/Enterococci	0.625
FC/Coliphage	0.557
E.coli/Coliphage	0.546
Enterococci/*C.perfringens*	0.432
Coliphage/*C.perfringens*	0.374
FC/*C.perfringens*	0.368

Correlations with Enterovirus in a Marine coastal system

Indicators against Enterovirus results	r value
Enterovirus/Enterococci	0.553
Enterovirus/Coliphage	0.457
Enterovirus/Fecal Coliforms	0.442
Enterovirus/*E.coli*	0.370
Enterovirus/*Clostridium perfringens*	0.199

In studies children were 3X more likely to develop diarrhea and respiratory infections

Risk of infections significantly higher when swimming in contaminated water.

Respiratory infections

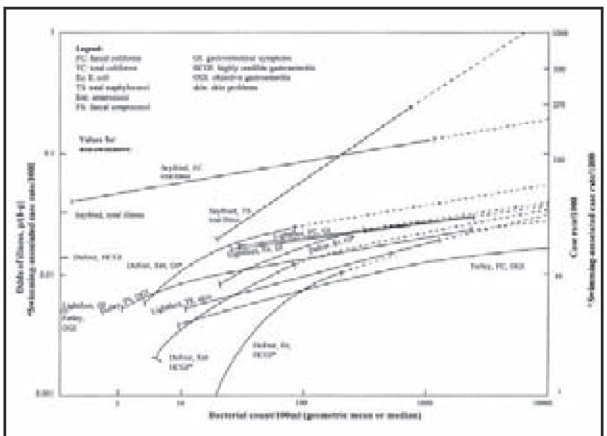
Skin infections

Eye/ear and nose infections

Gastrointestinal infections

Health Data Associated with Swimming in Polluted Waters

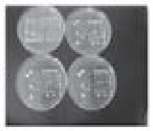
- Disease endpoints: Respiratory, gastrointestinal, ear, eye, nose and skin infections.
- England: respiratory most common, 24% had one symptom.
- Santa Monica Bay, CA: gastrointestinal, 3.7%, associated with storm drains.
- Key West, FL: gastrointestinal most common, 33% associated with leaky sewer, liveaboards.



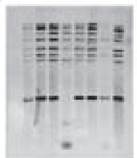
Meta Analysis Jack Colford

- Recreational Epidemiological Studies
- Enterococci demonstrated the best statistical association in Marine Waters and was a good statistical fit in Fresh Waters
- E.coli was the best indicator of risk in Fresh Waters
- Coliphage and Enteric virus showed some relationship, however only a few studies.

Bacterial Source Tracking
Library-based methods
"Fingerprinting" Indicator Bacteria



- Antibiotic Resistance Analysis
- ➪ phenotype



- Ribotyping
- ➪ genotype

Source Tracking Round Robin Study

J. Water and Health Vol 1, No. 4 Dec. 2003

- 22 researchers 12 methods.
- 12 prepared samples
- 4 contained untreated sewage
- 4 contained human feces
- 5 contained cow feces
- 4 contained dog feces
- 4 contained gull feces

Results

- F+ Specific Coliphage were isolated at high concentrations from all samples that had sewage.
- Typing did not address source
- Human feces were negative

- Antibiotic Resistance gave 39-66% False positives
- Ribotyping , Rep PCR and PFGE gave 14-33% False positives
- Small library
- Fecal Streptococci performed better

Host Specific Markers

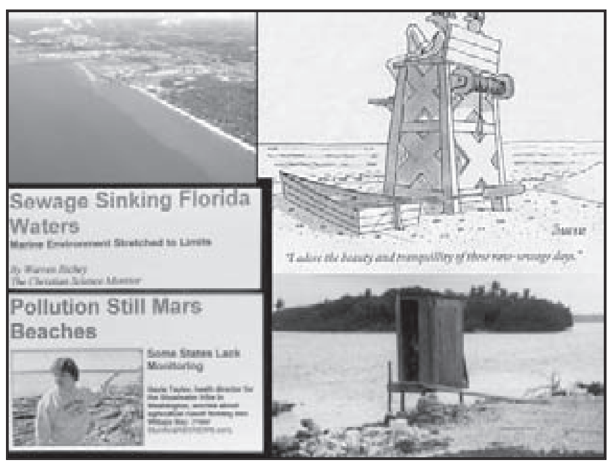
- Bacteroides (PCR)
- 4/4 sewage; 4/4 human; 4/5 cow (lowest concentration missed) 4/4 dogs however no marker for Birds: Missed 2 samples with dog and 2 with cow that were mixed.

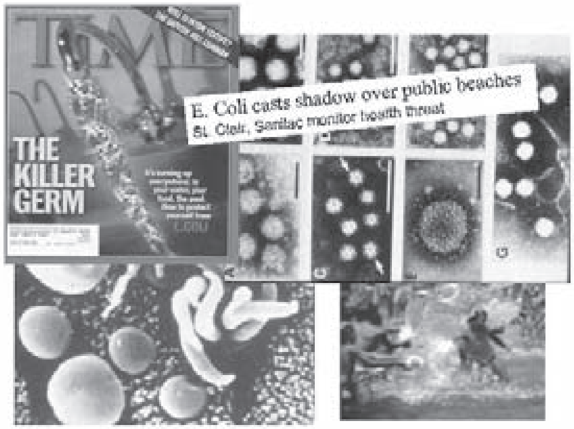
- E.coli Toxin genes able to detect sewage (4/4).

- Enteroviruses and Adenoviruses found in 3 of 4 sewage samples.

Source Tracking at MSU

- Recently developed method to track a Human marker in Enterococci.
- 107/109 samples from human sewage and septic tanks were positive.
- 0/80 samples from cattle, swine, bird, fecal samples and lagoons were positive.
- Enterococci proposed as a better indicator of recreational risk and groundwater risk, thus this marker can give the source of that risk.
- Can be used with Enterolert or membrane filtration methods.





EnteroVirus Detection in Coastal Waters

• Greece	• 21%
• Italy	• 32%
• Spain	• 44%
• Florida	• 79% PCR;20% cult.
• Hawaii	• 8% cult.
• Texas	• 40 to 72%

AdenoVirus Detection in Coastal Waters

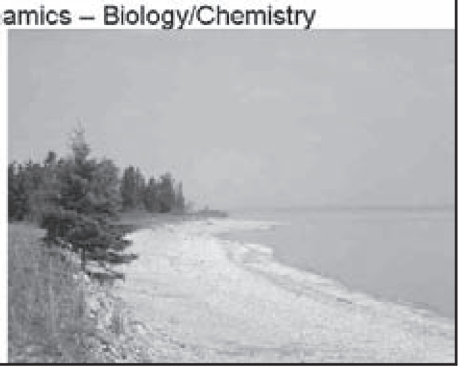
• Greece	• 34%
• Spain	• 78%
• California	• 33%

Other viruses detected include Norwalk virus (11%); HAV (33-63%); Reoviruses (3-30%)

TECHNOLOGIES FOR PROTECTION OF RECREATIONAL WATER QUALITY AND HEALTH

- Quantitative Risk Assessment to frame the assessment of human health implications
- Methods to Characterize human health hazards and the sources via monitoring for Enteric bacteria, viruses, *Cryptosporidium* and *Giardia*
- Watershed approach: environmental factors impacting water quality impairment
- Apply new technology and tools for source tracking and evaluate transport and fate

MODELING: LAND-WATER
Climate –Meterology –Hydrology – Hydrodynamics – Biology/Chemistry



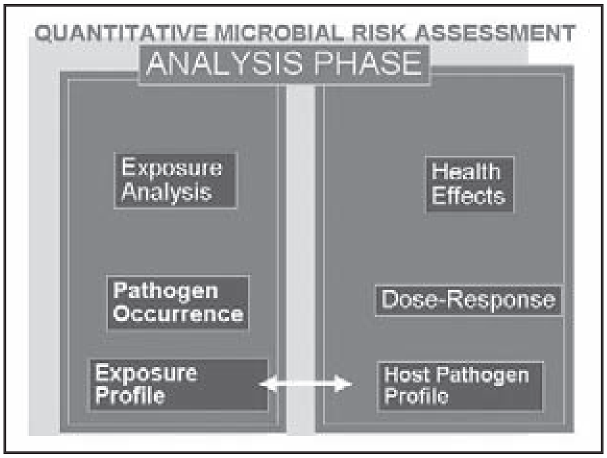
NATIONAL ACADEMY OF SCIENCES RISK PARADIGM

HAZARD IDENTIFICATION
Types of microorganisms and disease end-points

DOSE-RESPONSE
Human feeding studies, clinical studies, less virulent microbes and health adults

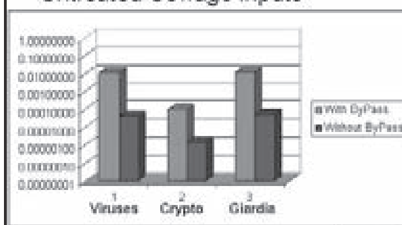
EXPOSURE
Monitoring data, indicators and modeling used to address exposure

RISK CHARACTERIZATION
Magnitude risk, uncertainty and variability

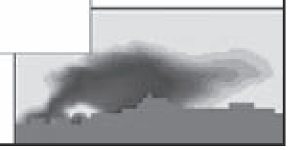


Beach Risks

Untreated Sewage inputs



Monitoring
Hydrodynamic modeling
QMRA



Recommendations for Florida Beaches

Evaluation of Indicators: Phase A

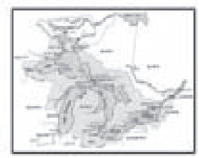
- The use of two indicators is warranted, Fecal Coliforms still have merit and Enterococci should be added.
- Coliphage should be added as a third indicator in areas with fresh water inputs and study of storm events.

Application of technology: Phase C

- Source tracking was used and correlated human sources with virus pathogens presence. Septic tanks and storm water.
- **Environmental impacts & Risk: Phase B**
- Rainfall linked to water quality, cumulative over 3 to 10 days, but other environmental factors are contributing.
- Enteroviruses are impacting coastal waters.

The Great Lakes

- Largest freshwater source in the world
- 10,000 miles of coastline in 8 different states
- 1/10th the population of U.S. is in basin
- $4 billion commercial and sport fishing industry
- Over 500 recreational beaches



•14% of monitored Great Lakes beaches are closed 10% of the time (2002)

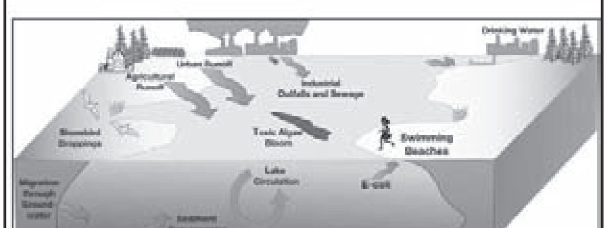
The Great Lakes Initiative in Wisconsin

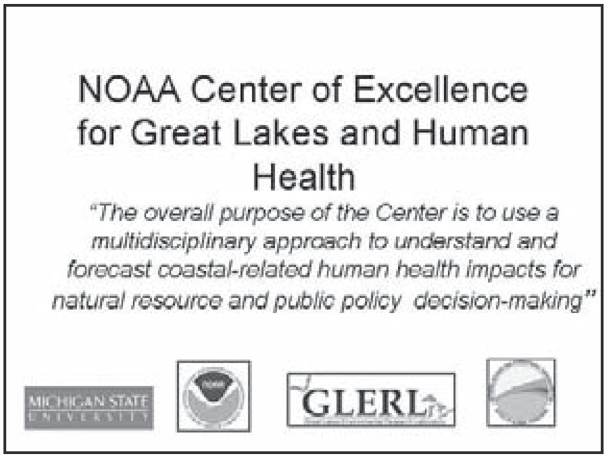
Uniform monitoring and notification for swimmers.

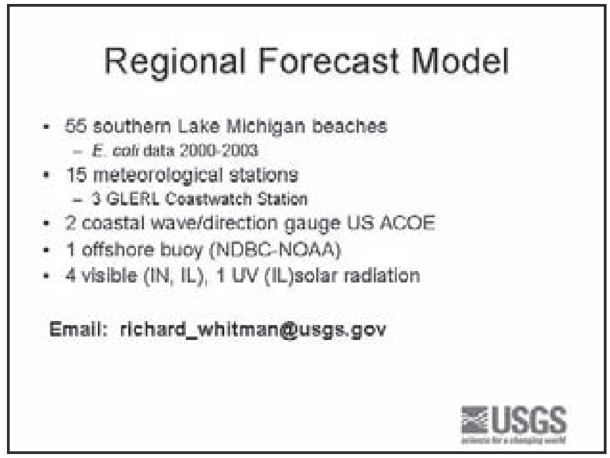
July, 2002 Nicolet Bay, Peninsula State Park, Door County, northern Green Bay, WI

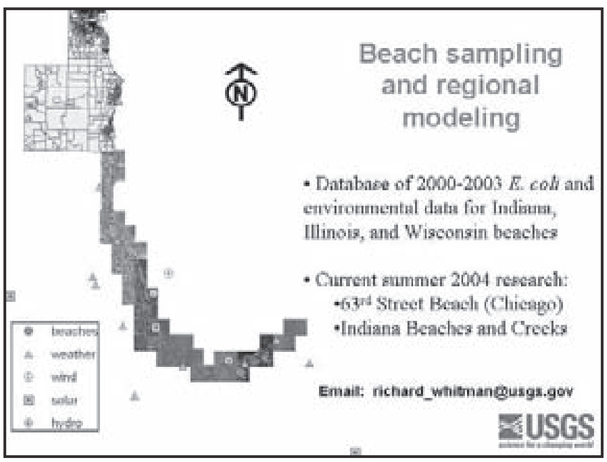
60 swimmers, nausea, diarrhea, 2 hospitalizations.

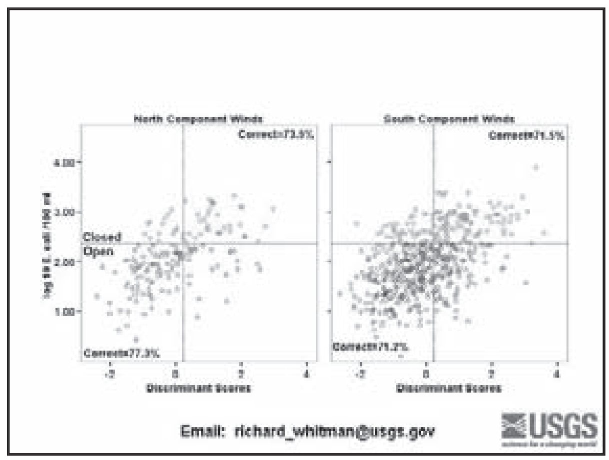
Factors Contributing to Human Health in the Great Lakes

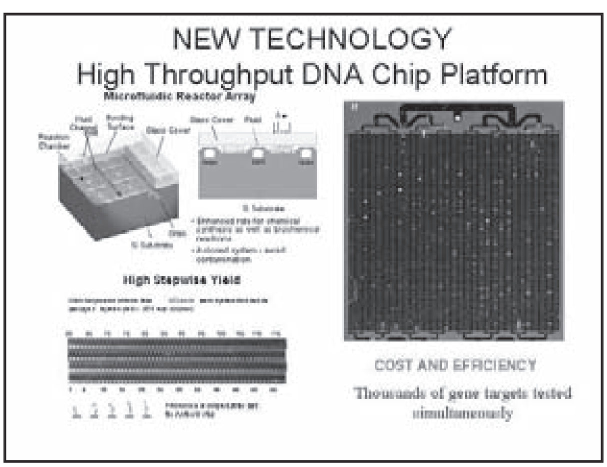


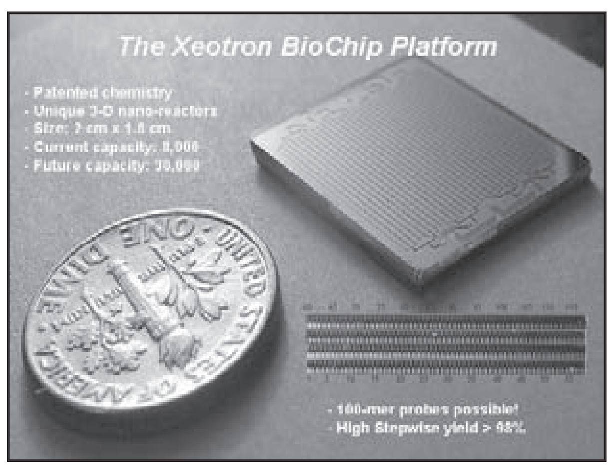

NOAA Center of Excellence for Great Lakes and Human Health
"The overall purpose of the Center is to use a multidisciplinary approach to understand and forecast coastal-related human health impacts for natural resource and public policy decision-making"
MICHIGAN STATE UNIVERSITY
GLERL


Regional Forecast Model
• 55 southern Lake Michigan beaches
– E. coli data 2000-2003
• 15 meteorological stations
– 3 GLERL Coastwatch Station
• 2 coastal wave/direction gauge US ACOE
• 1 offshore buoy (NDBC-NOAA)
• 4 visible (IN, IL), 1 UV (IL)solar radiation
Email: richard_whitman@usgs.gov
USGS

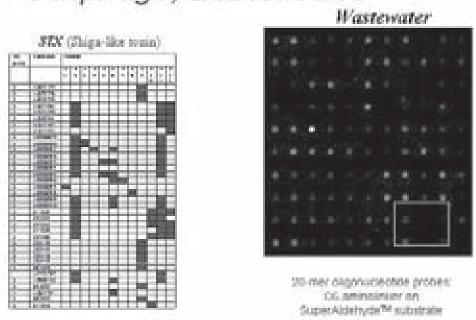

Beach sampling and regional modeling
• Database of 2000-2003 E. coli and environmental data for Indiana, Illinois, and Wisconsin beaches
• Current summer 2004 research:
•63rd Street Beach (Chicago)
•Indiana Beaches and Creeks
Email: richard_whitman@usgs.gov
beaches
weather
wind
solar
hydro
N
USGS


North Component Winds
Correct=73.5%
Correct=77.3%
South Component Winds
Correct=71.5%
Correct=71.2%
Closed
Open
Discriminant Scores
Email: richard_whitman@usgs.gov
USGS


NEW TECHNOLOGY
High Throughput DNA Chip Platform
Microfluidic Reactor Array
High Stepwise Yield
COST AND EFFICIENCY
Thousands of gene targets tested simultaneously

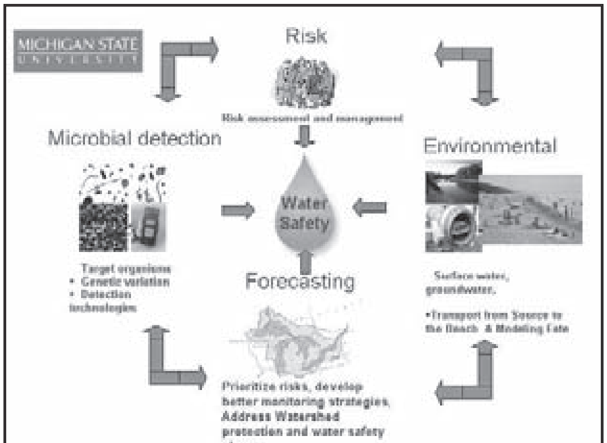

The Xeotron BioChip Platform
- Patented chemistry
- Unique 3-D nano-reactors
- Size: 2 cm x 1.8 cm
- Current capacity: 8,000
- Future capacity: 30,000
- 100-mer probes possible!
- High Stepwise yield > 98%

Indicator Source and Risk Biochip: E.coli, Enterococci, Coliphage, Bacteriodes



The FUTURE

- More studies are needed
- Political Will
- Longer term strategy for studying microorganisms and water quality
- Funding for surveys
- Application of new technology; better and more specific information.
- BETTER PROTECTION OF WATERS
- ABILITY TO PRIORITIZE
- LONG TERM SUSTAINABILITY



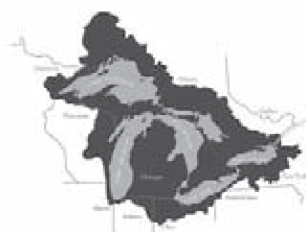
THANK YOU

QUESTIONS

Center of Excellence Website:

- http://www.glerl.noaa.gov/res/Centers/HumanHealth/

Joan B. Rose, rosejo@msu.edu



Wednesday, October 13

10:20 a.m. – 12:00 p.m.

Session Two: State and Local Experiences in Implementing Beach Monitoring & Notification Programs

Hawaii Watershed Initiative and Clean Beaches

Carl Berg
Hanalei Watershed Hui

Biosketch

Dr. Berg is Chief Scientist of the Hanalei Watershed Hui; a community based non-profit organization on Kauai. Dr. Berg received his B.A .in Zoology from the University of Connecticut, his M.S. in Marine Science from the University of the Pacific, and his Ph.D. in Zoology from the University of Hawaii. He was a professor at City College of New York, a research associate at Harvard and Columbia universities, a staff scientist at the Marine Biological Laboratory in Woods Hole, and a Biological Scientist at the Florida Marine Research Institute. His research focused on population ecology of marine invertebrates on islands in the Caribbean and in the deep sea at hydrothermal vents. He retired to Kauai in 1990, but briefly worked for the Hawaii Department of Health monitoring water quality in the ocean and streams. He later volunteered as water quality monitoring coordinator for the Hanalei Heritage River Program, assuming the role as Chief Scientist as it morphed into the Hanalei Watershed Hui.

Abstract

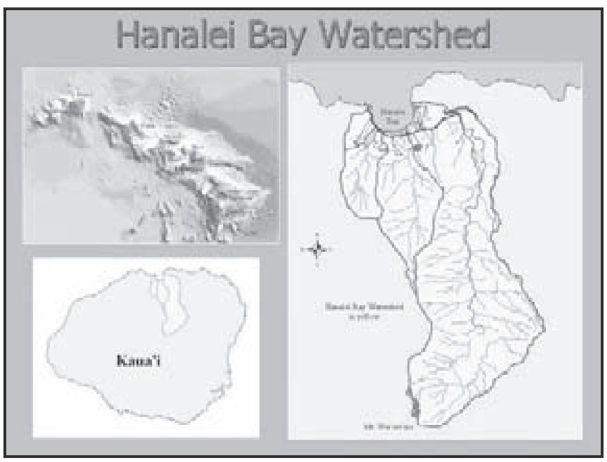
Hanalei Watershed Hui began monitoring waters of Hanalei Bay in 2000 because of community based concerns over pollution by people living aboard boats anchored in the Bay during the summer. Samples were collected by volunteers and analyzed for bacteria by the Hawaii Department of Health laboratory. No evidence of discharge was obtained, but the monitoring program has continued. We have found no correlation between the number of boats in the Bay and the bacteria counts.

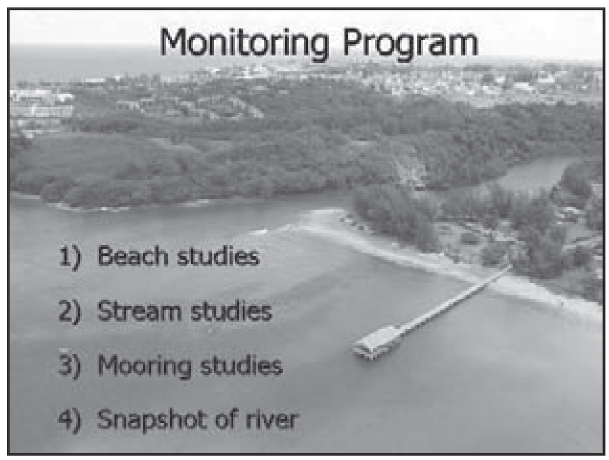
Starting in 2001, the Hui began its own monitoring program for Enterococcus bacteria using IDEXX Enterolert and Quanti-Tray technologies to supplement DOH sampling, spatially and temporally. Samples were taken at three beach parks on Hanalei Bay during periods of peak use, weekends and holidays, and in four recreational streams entering the Bay. Snapshot sampling was done in the Hanalei River and its tributaries to identify sources of contamination. This information was provided to the Hawaii DOH to aid its efforts in monitoring water quality and in identifying sources of contamination. It was also considered in listing Hanalei River in the Hawaii 303d list of impaired waters.

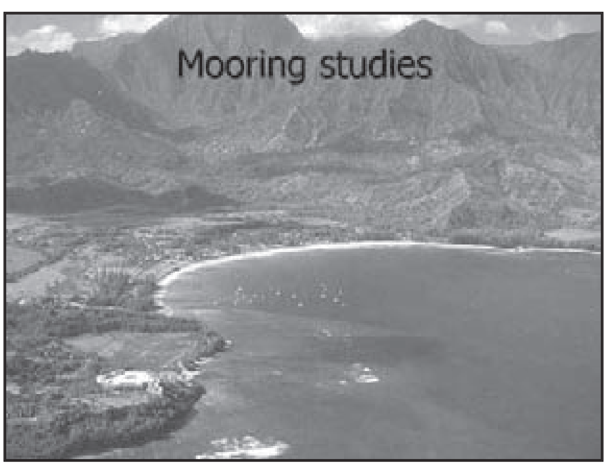
Results of the weekend testing for Enterococcus bacteria are provided to the community via popular surf reports on local public radio (KKCR). Reports of the overall testing program are provided via community meetings, newsletters, our website (www.Hanaleiriver.org), radio talk shows, and in a regular public television forum series. Our staff and volunteers are frequently asked "How is the water?" as they are out on the beach or in the community.

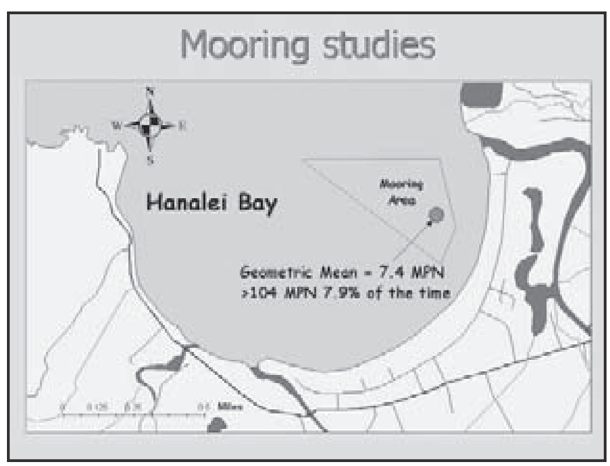

Hanalei Watershed Hui

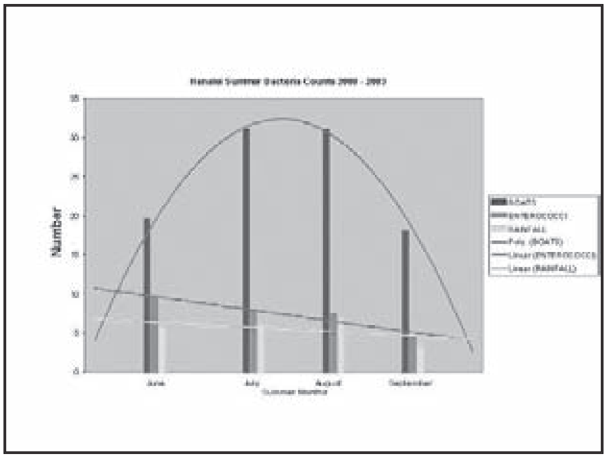

Hanalei Watershed Initiative
Monitoring Hanalei's Waters
Dr. Carl J. Berg, Jr.

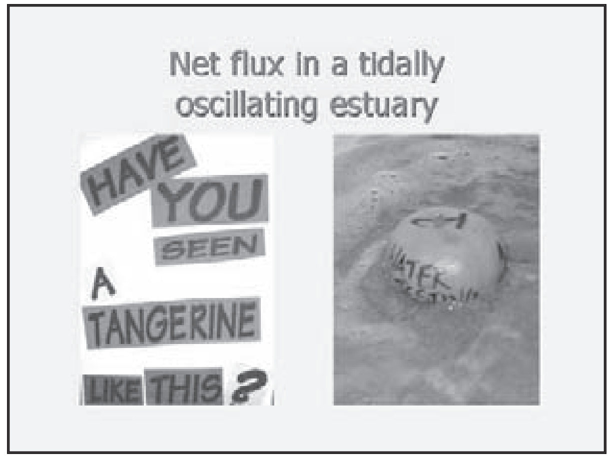

Hanalei Bay Watershed
Kaua'i

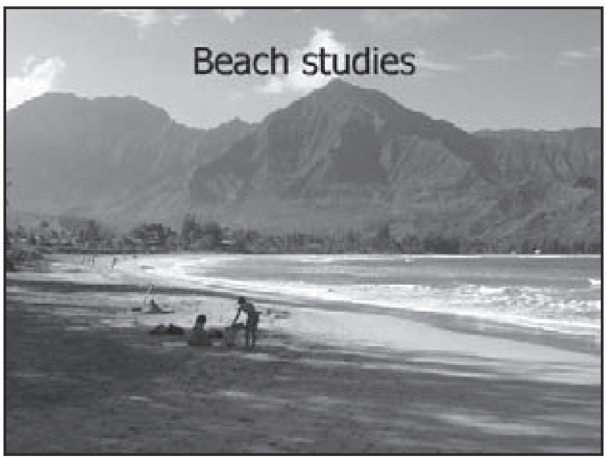

Monitoring Program
1) Beach studies
2) Stream studies
3) Mooring studies
4) Snapshot of river

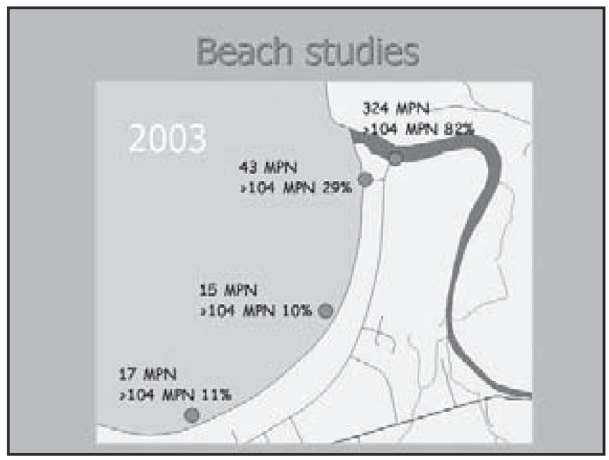

Mooring studies


Mooring studies
N
W
E
S
Hanalei Bay
Mooring Area
Geometric Mean = 7.4 MPN
>104 MPN 7.9% of the time
Miles

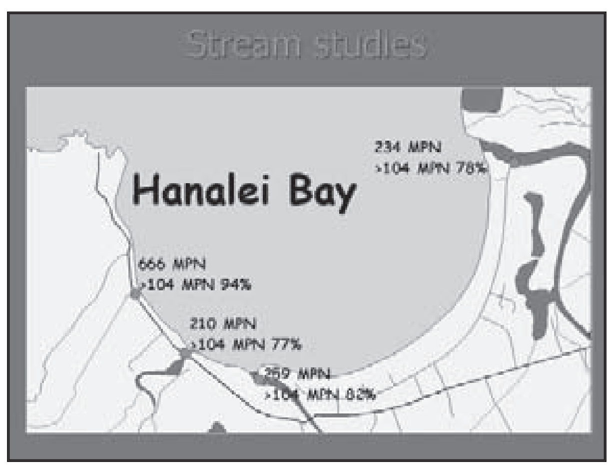

Number
June
July
August
September

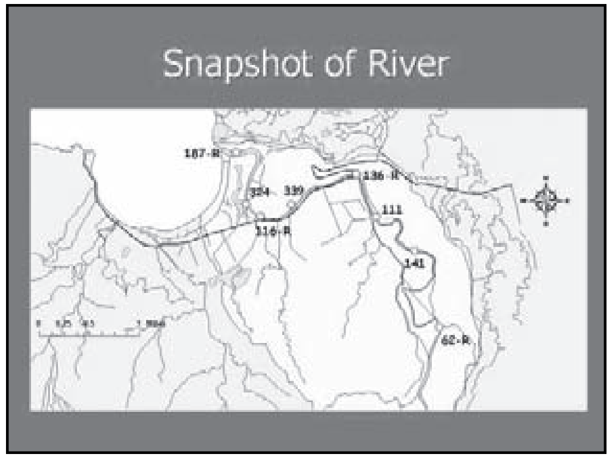

Net flux in a tidally
oscillating estuary
HAVE
YOU
SEEN
A
TANGERINE
LIKE THIS ?


Beach studies


Beach studies
2003
324 MPN
>104 MPN 82%
43 MPN
>104 MPN 29%
15 MPN
>104 MPN 10%
17 MPN
>104 MPN 11%

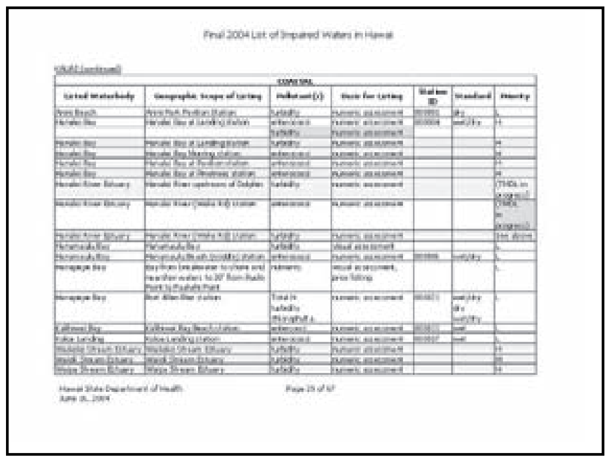

Stream studies


Stream studies
Hanalei Bay
234 MPN
>104 MPN 78%
666 MPN
>104 MPN 94%
210 MPN
>104 MPN 77%
269 MPN
>104 MPN 82%



Working with Hawaii Department of Health

Supplemental Monitoring
Source Identification
303 (d) Listing
TMDL

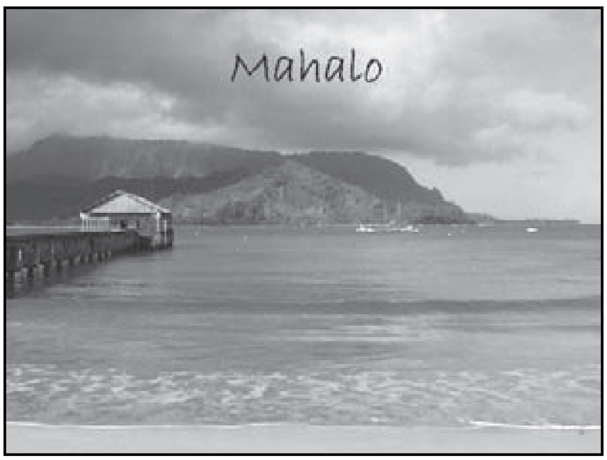


NRDC report "suspicious" of isle beaches' spotless health record

- No beach closing in 2003
- HAR "Warning signs shall be posted at locations where human sewage has been identified as temporarily contributing to the enterococcus count."


Community Outreach
Surf Reports
Newsletter
Website
Community Meetings
Ho'ike – Public Television


Mahalo to the
Hanalei Watershed Hui Staff
Jan Surface
Rick Copeland
Carrie Johnson


Mahalo

Questions and Answers

Q: It was noticed that river bacteria readings were lower in the upper watershed and higher in lower watershed. The lower watershed levels compared to levels in southern California. Sometimes the levels in Southern California are higher (in the thousands) and reduced closer to the mouth, but in Southern California we see bacterial blooms, shore birds, ponding, and regrowth, near the river mouth. Why do the levels in Hawaii drop off as the river gets closer to the ocean?

Carl Berg

The drop of bacteria levels at the mouth is due to estuary mixing, as evidenced by the salinity values. A dilution occurs.

Q: Have you taken groundwater samples? The presence of a cesspool may not be the cause of groundwater contamination. Are there studies that show that bacteria can travel a long distance through the earth?

Carl Berg

No groundwater study was done, but there are studies that show that viruses can go 100 yards or more in a short period of time through soils. The area is sandy soils and our studies have looked at other tracers (such as estrogen levels) that show that the groundwater can get into the rivers. The Hanalei area gets enough rain to put the beach areas under water at certain times during the year. To visitors in these areas, the cesspool contamination is obvious. Cesspool contamination occurs. Restroom facilities overflow and cause groundwater contamination.

Q: Leptospirosis is a problem in those streams and is spread primarily through urine, rather than feces. Could you predict which streams were likely to cause leptospirosis disease in humans?

Carl Berg

Leptospirosis is extremely important to study in the lake areas. The only evidence that I have for the presence of *Leptospira* is of people getting sick from the streams. There is no effective, fast way to measure *Leptospira* in the waters. Some people have been sick and/or died from contact with streams in Kauai, and larger rivers in Hawaii. Leptospirosis is prevalent in the state of Hawaii and the major streams are posted with warnings. They are not posted for *Cryptosporidium* and *Giardia*, even though they are contaminated with them. We are trying to develop an effective, quick means for measuring *Leptospira* in waters for better warnings.

Comment: There was an outbreak of aseptic meningitis in a hospital day care center. It was fecally spread by a virus. I'm concerned that there may be another outbreak of aseptic meningitis because it may be linked to one of the enteroviruses.

Carl Berg

Thank you for your comment and I would like to talk to you more about that.

Florida's Healthy Beaches Monitoring Program

Bart Bibler
Florida Department of Health, Bureau of Water Programs

Biosketch

Mr. Bart Bibler is Chief of the Florida Department of Health's Bureau of Water Programs. Mr. Bibler is an Environmental Engineer with primary focus on water quality and water management. He served as Director of Environmental Health and Engineering in Collier County, Florida. He was the Water Management Administrator for the Florida Department of Environmental Protection. And, he previously worked in the private sector, including the Orlando, Florida office of Camp, Dresser & McKee, Inc.

Abstract

Florida has a statewide coastal beach water quality-monitoring program to help ensure healthy beaches. The 2000 Florida Legislature enacted Senate Bill 1412 and House Bill 2145 (the Appropriations Act) authorizing and funding the Department of Health to conduct water quality monitoring of saltwater and brackish beaches. The federal BEACH Act, administered by the United States Environmental Protection Agency, supplemented the state funding with roughly an equal amount of federal funds. The Healthy Beaches Monitoring Program includes 34 of Florida's coastal counties sampling 305 sites once every week. These samples are analyzed for two types of enteric bacteria, fecal coliform and enterococci. The primary purpose of the Healthy Beaches Monitoring Program is to determine whether Florida has significant beach water quality problems, to provide this information to the public, and to gauge where or whether future beach monitoring efforts are necessary.

Fecal coliform and enterococci are both enteric bacteria, normally inhabiting the intestinal tract of humans and animals. The presence of enteric bacteria is an indication of fecal pollution, which may come from stormwater runoff, pets and wildlife, and human sewage. If they are present in high concentrations in recreational waters and are ingested while swimming or enter the skin through a cut or sore, they may cause human disease, infections or rashes.

The sampling results obtained through the program are automatically uploaded by the coastal county health departments onto the Department of Health's Internet Beach Water Quality website (www.doh.state.fl.us, click on the drop down arrow next to "-Choose Subject-" and then select "Beach Water Quality"). In addition, any advisories or warnings are promptly forwarded to the appropriate media.

Florida Healthy Beaches Program

Bart Bibler, P.E., Chief
Bureau of Water Programs

FLORIDA DEPARTMENT OF HEALTH

DIVISION OF Environmental Health

Florida Healthy Beaches Monitoring Program

Introduction

- Until 2000 Florida did not have funding allocated to regularly monitor coastal beaches, resulting in a "Bum" classification from the press and environmental groups.
- In 2000 the state legislature established the Florida Healthy Beaches Program and provided a recurring appropriation of $525,000 per year for the water quality monitoring of saltwater and brackish beaches.
- Chapter 514.023, F.S. gives the department the authority to monitor coastal beach waters and issue advisories when conditions exceed the standards.

Florida Healthy Beaches Monitoring Program

Introduction (cont)

- From August 2000 to August 2002, Florida's 34 coastal counties conducted beach water sampling every two weeks.
- The coastal counties implemented statewide guidance to ensure that testing frequency, laboratory methods, result interpretations, and actions were consistent.

Federal BEACH Act

Beaches Environmental Assessment and Coastal Health (BEACH) Act:

Allows EPA to award grants to eligible States and Territories to develop and implement work products consistent with BEACH Act requirements.

- Florida was allocated approximately $530,000 in 2002, $544,000 in 2003, and $540,220 in 2004.
- This allocation has allowed Florida to meet EPA guidelines through weekly sampling, beginning August 2002.

Florida Healthy Beaches Monitoring Program

Water Quality Data

- The initial focus of the Florida Healthy Beaches Program was to gather and evaluate the coastal beach water quality data, and determine whether there were any beach sites with chronic water quality problems.
- Currently, evaluations are being conducted to see if there are relationships between poor water quality and environmental factors such as rainfall or water temperature.
- Determine which sites have had 21 or more advisory days/year and correlate rainfall levels to indicator values.

Florida Healthy Beaches Monitoring Program

Water Quality Data

- A DOH/DEP TAC will consider rule revisions and predictive models for issuing advisories.
- Beach monitoring data is loaded into EPA's national STORET database every 3 months.
- Advisory days by sample site are supplied to DEP for the Impaired Waters Rule upon request – usually every 3 months.

Florida Healthy Beaches Monitoring Program

Testing has helped counties identify problems and take steps to correct.

There are over 300 beach sampling sites.

Approximately 42,000 samples have been collected since August 2000.

Florida Healthy Beaches Monitoring Program

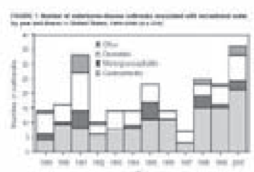
The coastal beach water samples collected by the county health departments are analyzed for enterococci and fecal coliform bacteria, which indicate the probable presence of animal (including human) waste and pathogens.

These indicators are found in the intestines of warm-blooded animals and are excreted in their waste.

Indicators are useful because it would be difficult and costly to attempt to directly detect the many different pathogens or parasites that can be found in surface waters.

Florida Healthy Beaches Monitoring Program

If waste pathogens are present in high concentrations in recreational waters and are ingested while swimming or enter the skin through a cut or sore, they may cause gastrointestinal illnesses, infections or rashes.



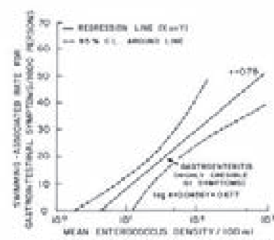
CDC. "Surveillance for Waterborne-Disease Outbreaks — United States, 1999-2000." MMWR 2002;51(SS-8).

http://www.cdc.gov/mmwr/PDF/ss/ss5108.pdf

Florida Healthy Beaches Monitoring Program

EPA's "Ambient Water Quality Criteria for Bacteria – 1986" is based on epidemiological studies to evaluate the relationship between swimming in contaminated waters and illness rates.

Enterococci had the strongest correlation to swimmer illness rates.



EPA. "Health Effects Criteria for Marine Recreational Waters." August 1983; EPA-600/1-80-031.

Florida Healthy Beaches Monitoring Program

Bacterial Indicator Standards

Florida's adopted indicator organism for bacterial contamination is fecal coliform, as promulgated by the Florida Department of Environmental Protection.

In 1986, the federal Environmental Protection Agency revised their criteria to recommend the bacterial indicator enterococci, which provides equivalent protection but is considered a better indicator of the presence of human waste.

The Department of Health is utilizing the 1986 guidance to implement enterococci monitoring while also monitoring for fecal coliform to fulfill both Federal and State requirements.

Florida Healthy Beaches Monitoring Program

What this means

County Health Departments collect samples every week and compare results to the standard for the Single Sample Maximum (SSM).

Measures instantaneous water quality conditions.

If an enterococci result exceeds a SSM of 104 colony forming units (CFU) per 100 milliliters of beach water sampled and a resampling result also exceeds this value, then an "**Advisory**" will be issued.

If a fecal coliform result exceeds a SSM of 400, and this is confirmed, a "**Warning**" will be issued.

Florida Healthy Beaches Monitoring Program

Geometric Mean

- With the collection of weekly samples, DOH is calculating a Geometric Mean (GM) for enterococci.
  - A reflection of average conditions.
  - Calculated with the five most current sample periods, including any resampling data.
- The GM action limit for enterococci is 35 CFU/100 mL.

Public Notification

Advisories and Warnings

County health departments issue health advisories or warnings when these conditions are confirmed. If a resample cannot be collected and posted on the web page before the end of the sample period, the advisory or warning will be issued with the first poor result.

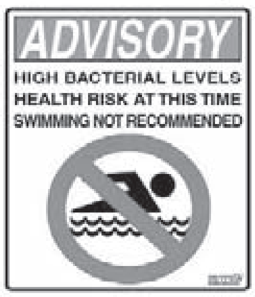
Any advisories or warnings are promptly sent to the appropriate media outlets, local officials, and the State Health Office.

Additional resampling of monitoring sites after advisories or warnings have been issued is conducted at the discretion of the county health departments.

Public Notification

Measures to inform the public about advisories or warnings:

- Results are posted on the website.
- A sign is posted parallel to the sample location for the beach and at points of access.
- The media are notified.



Florida Healthy Beaches Monitoring Program

Data Entry website

Florida Healthy Beaches website

Florida Healthy Beaches Monitoring Program

Results to Date

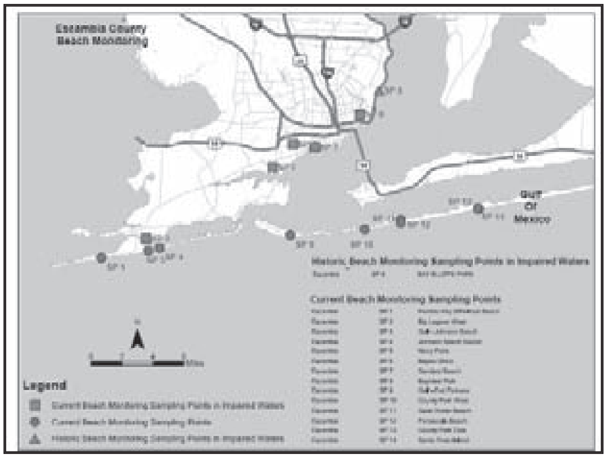
- Florida's coastal counties have reported a total of 1664 poor enterococci single sample levels, 1186 enterococci geometric mean exceedances, 746 poor fecal coliform results, and 1766 advisories/warnings from August 2000 to March 2004 (n=43,451).
- To put this in perspective, these numbers mean that 3.8% of the enterococci samples were poor, 4.7% of the geometric mean results exceeded the standard, and 1.7% of the fecal coliform samples were poor.

Florida Healthy Beaches Monitoring Program

Results to Date

- 3 counties (Brevard, Citrus, Flagler) have had no poor results and 1 other county (St. Lucie) has never had to issue an advisory/warning (the six exceedances have had resamples within acceptable limits).
- 4 counties (Escambia, Okaloosa, Wakulla, and Pasco) exceed state percentages for all four variables (enterococci, entero geomean, fecal coliform, and advisories)
- Taylor County has the highest percentage of advisories.

County	N	Enterococcus Exceeds	%	[illegible] Exceeds	N	%	Fecal Coliform Exceeds	%	Advisories	%
Brevard	1353	0	0.0%	0	780	0.0%	0	0.0%	0	0.0%
Citrus	133	0	0.0%	0	78	0.0%	0	0.0%	0	0.0%
Flagler	798	0	0.0%	0	488	0.0%	0	0.0%	0	0.0%
St.Lucie	805	6	0.7%	0	385	0.0%	1	0.1%	0	0.0%
Martin	1392	16	1.2%	0	889	0.0%	1	0.1%	1	0.1%
St.Johns	1088	8	0.7%	0	812	0.0%	2	0.2%	1	0.1%
Duval	1343	13	1.0%	0	773	0.0%	0	0.0%	2	0.1%
Walton	1115	14	1.3%	0	887	0.0%	10	0.9%	5	0.5%
Santa Rosa	940	11	1.2%	4	540	0.7%	1	0.1%	3	0.3%
Lee	1702	31	1.8%	0	1015	0.0%	0	0.0%	9	0.5%
Sarasota	2053	18	0.9%	13	1233	0.0%	2	0.1%	11	0.5%
Nassau	1269	10	0.7%	2	836	0.2%	0	0.0%	10	0.7%
Collier	1952	67	2.0%	5	1120	0.4%	16	0.0%	24	1.0%
Dade	2124	104	[illegible]	17	1221	1.4%	44	[illegible]	28	1.0%
Indian River	1039	28	2.7%	2	472	0.4%	11	1.1%	20	1.0%
Pinellas	1903	139	[illegible]	43	1153	3.7%	72	[illegible]	39	2.0%
Palm Beach	1952	97	[illegible]	35	1117	3.1%	11	0.6%	41	2.1%
Broward	2113	132	[illegible]	63	1222	[illegible]	58	[illegible]	67	3.2%
Manatee	1346	16	1.2%	43	789	[illegible]	5	0.4%	48	3.6%
Dixie	133	3	2.3%	4	76	[illegible]	0	0.0%	5	3.0%
Charlotte	1105	38	3.4%	37	636	[illegible]	4	0.4%	44	4.0%
Gulf	845	35	[illegible]	18	489	3.5%	14	1.7%	36	[illegible]
Hillsborough	1363	70	[illegible]	36	775	4.6%	65	[illegible]	63	[illegible]
Volusia	2083	61	3.0%	58	1222	[illegible]	1	0.0%	110	[illegible]
Monroe	2415	152	[illegible]	43	1303	3.3%	86	[illegible]	135	[illegible]
Hernando	135	3	2.2%	9	76	[illegible]	1	0.8%	9	[illegible]
Bay	1781	92	[illegible]	28	888	2.8%	98	[illegible]	120	[illegible]
Franklin	606	40	[illegible]	27	360	[illegible]	2	0.3%	40	[illegible]
Levy	136	4	3.0%	9	76	[illegible]	1	0.7%	10	[illegible]
Escambia	1882	139	[illegible]	137	1117	[illegible]	139	7.1%	108	[illegible]
Okaloosa	1554	83	[illegible]	136	913	[illegible]	35	2.3%	199	[illegible]
Pasco	906	66	[illegible]	138	657	[illegible]	5	3.3%	184	[illegible]
Wakulla	286	32	[illegible]	30	134	[illegible]	9	3.1%	62	[illegible]
Taylor	535	138	[illegible]	118	304	[illegible]	9	1.7%	189	[illegible]
Florida	40179	1976	3.0%	1108	23559	4.0%	701	1.7%	1672	4.0%



Web Pages of Interest

- CDC. "Surveillance for Waterborne-Disease Outbreaks — United States, 1999-2000." MMWR 2002;51(SS-8).
  http://www.cdc.gov/mmwr/PDF/ss/ss5108.pdf
- EPA's BEACH Program
  http://www.epa.gov/waterscience/beaches/
- Florida Healthy Beaches Program
  http://apps3.doh.state.fl.us/env/beach/webout/default.cfm

Questions and Answers

Q (Toni Glymph, Wisconsin Department of Natural Resources): When does a water get listed as impaired? Once you determine it has exceeded standards in one year, what happens if it doesn't the next year? Are waters listed because they have problems for more than one year?

Bart Bibler

Waters with problems tend to have chronic problems. A beach with a monitoring, clean-up project is often higher priority for TMDLs than a beach being on the list. Monitoring, advisories, and warnings have higher priority.

Q: It is interesting that the 21 exceedances criteria are based on EPA standards and the Department of Health is complying with that. I think we are all trying to understand why they chose 21 days. Is that the way we need to go?

Bart Bibler

They are relying on our issuance of advisories and warnings even ahead of having enterococci as the state water quality standard. I think that has been a leap on their part and has never been challenged. Even exceedances of enterococci, whether or not it is part of the state water quality standards, they count in consideration of characterizing a beach as having impaired water. We are appreciative that EPA is taking it seriously. We are also appreciative that county governments will move it even faster than waiting for TMDLs that might take 15 years to solve.

Surf and Turf: Developing Partnerships for Maine's Beaches

Esperanza Stancioff
University of Maine, Cooperative Extension/Sea Grant

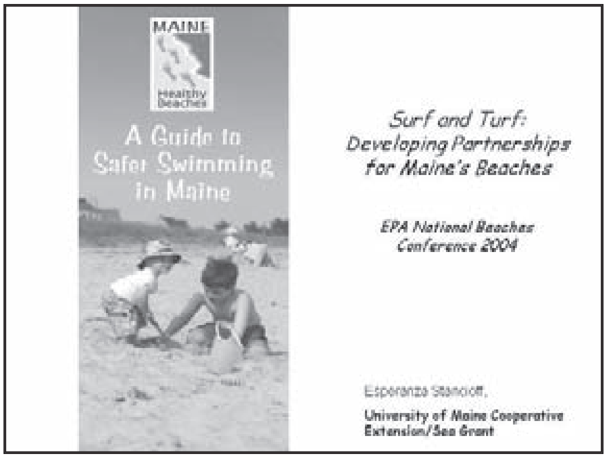
Biosketch

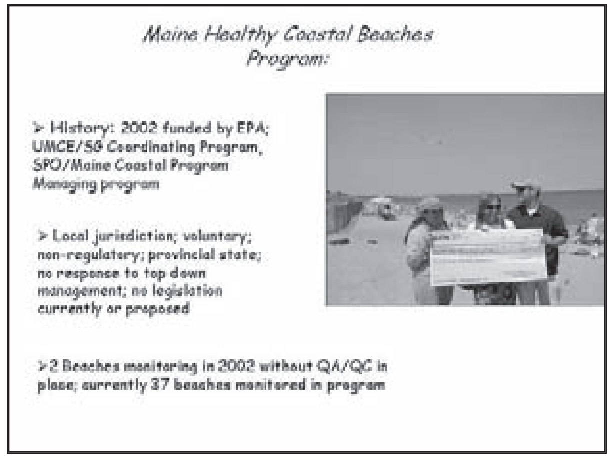
Ms. Stancioff received her BS in Marine Biology from Evergreen State College in Washington and her M Ed in Environmental Science from the University of Maine. Her work as Statewide Marine Extension Faculty with the University of Maine Cooperative Extension and Sea Grant focuses on Ecosystem Health including environmental monitoring, marine education, and community development. She developed one of the first coastal volunteer citizen water quality and phytoplankton monitoring efforts in the country. She works with state and federal agencies to direct and implement science and stewardship programs in assessment and remediation, planning and education.

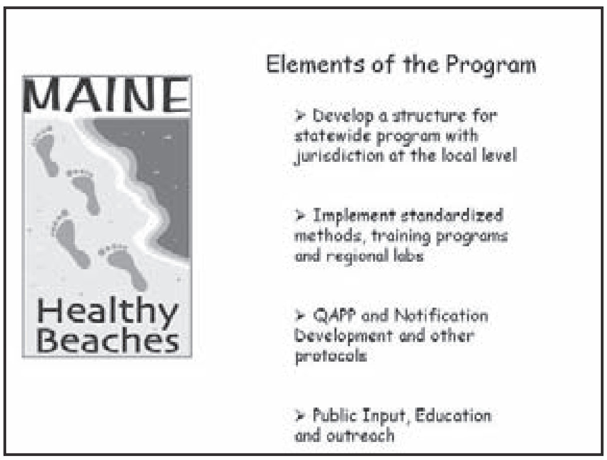
Abstract

Maine's challenge has been to develop a community-based volunteer water quality-monitoring program because the monitoring of water quality for swimming and other water contact usage is the responsibility of the local jurisdiction. It is not a mandated requirement from the State, nor does the State of Maine monitor public beaches other than State beaches. Maine rose to the test of unifying the protocols for monitoring, notification and education for coastal beaches through a stakeholder based process with representatives from the State, University, Nonprofit, NGOs and local municipalities which guided the development of the Maine Healthy Beaches Program.

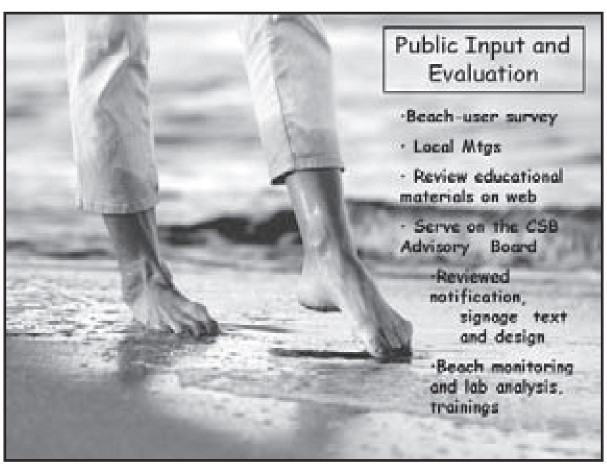
Maine has been faced with coordinating local municipalities and agencies that were implementing various approaches to monitor coastal water quality from drinking water standards to shellfish water quality standards to the US EPA's bacterial standard. The Maine Healthy Coastal Beaches Program required innovative and extensive coordinated public outreach and education efforts to provide the communities and agencies with the technical assistance and incentives to implement the program. Through the execution of a marketing campaign, involvement of local staff and volunteers and consistent one-on-one consultation from the University of Maine Cooperative Extension/Sea Grant, the program has gone from one (1) beach to thirty-six (36) in a two (2) year period of time.

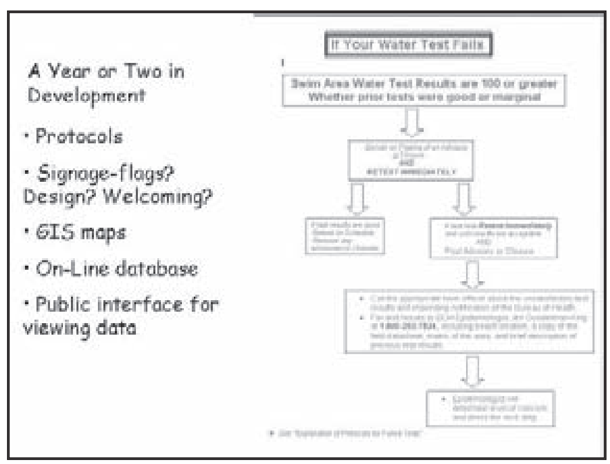

MAINE
Healthy Beaches
A Guide to Safer Swimming in Maine
Surf and Turf: Developing Partnerships for Maine's Beaches
EPA National Beaches Conference 2004
Esperanza Stancioff,
University of Maine Cooperative Extension/Sea Grant


Maine Healthy Coastal Beaches Program:
➢ History: 2002 funded by EPA; UMCE/SG Coordinating Program, SPO/Maine Coastal Program Managing program
➢ Local jurisdiction; voluntary; non-regulatory; provincial state; no response to top down management; no legislation currently or proposed
➢2 Beaches monitoring in 2002 without QA/QC in place; currently 37 beaches monitored in program


MAINE
Healthy Beaches
Elements of the Program
➢ Develop a structure for statewide program with jurisdiction at the local level
➢ Implement standardized methods, training programs and regional labs
➢ QAPP and Notification Development and other protocols
➢ Public Input, Education and outreach


Partners-statewide and local:
UMCE/Sea Grant, MCP, DEP, BoH, DMR, DOC, EPA, Municipal Officials, State Park Personnel, Nonprofit Groups and Volunteers, EPA
Engaged In: Structure, Resources, Training, Implementation, Evaluation
Who's Involved
Pros and Cons to our Program:
· Community support into the future—only way possible in ME
· Lengthy process to engage all
·Stewardship activity and educational opportunities strong
·Turnover in staff an issue-funding essential


Public Input and Evaluation
·Beach-user survey
· Local Mtgs
· Review educational materials on web
· Serve on the CSB Advisory Board
·Reviewed notification, signage text and design
·Beach monitoring and lab analysis, trainings


A Year or Two in Development
· Protocols
· Signage-flags? Design? Welcoming?
· GIS maps
· On-Line database
· Public interface for viewing data
If Your Water Test Fails
Swim Area Water Test Results are 100 or greater
Whether prior tests were good or marginal

What Do the Numbers Mean?

- The bacteria test is just one tool in assessing water quality conditions
- What have the bacteria results been in the past? Is there a history of problems or has this site always tested fine?
- Other factors are: conditions at that site, i. E. dog feces, boats contributing waste, high numbers of people, warm shallow water, poor practices, storm events

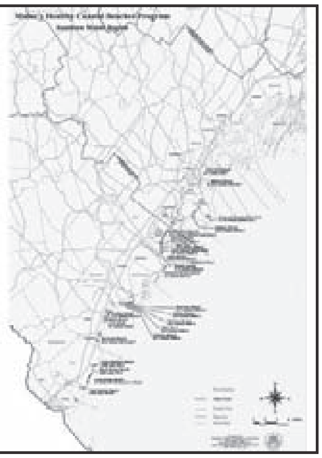
Sources of Information in Local Decision Making:

- Enterococci analysis
- Risk Assessment Matrix
- Sanitary Shoreline Survey

Story of the Signs

Tools Provided to Communities

- GIS Maps of sites & distance
- On-line database
- Technical expertise at town mgs and councils
- Analysis of pollution problems and community devpt process for remediation
- Presentations—many presentations



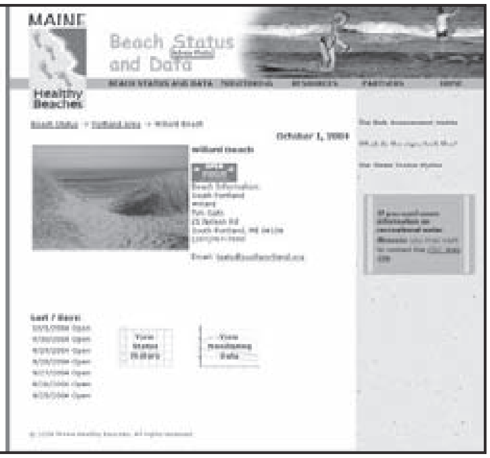
On-Line Database

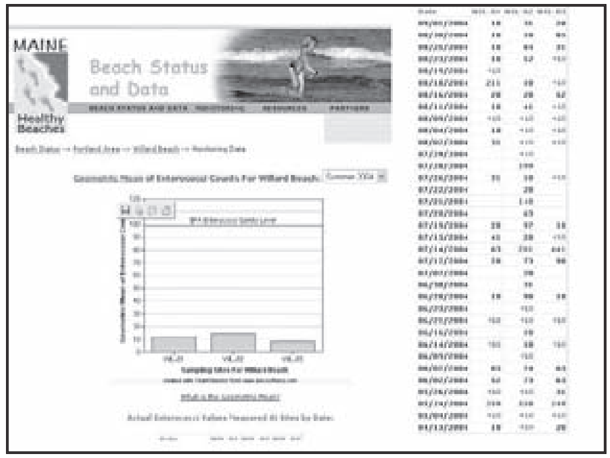
Public Interface to MHCB Data

On-Line December 2004

Monitoring Sites in Casco Bay

"NRDC Beach Buddy"





Beach Status Updated every 24 hours-advisories and closures automated email to managers

Program Mantra to Public

Beaches are not "closed" simply on the exceedance of the bacterial count, but on the Risk Assessment Matrix factors which includes bather numbers, time of last rainfall, and history of known problems. This is a coordinated decision between the Beach Manager, Program Coordinator, and State Epidemiologist.

Community Examples

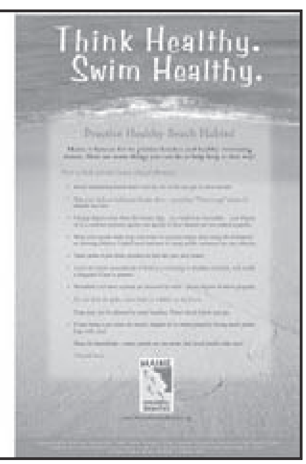
- MDIWQC-Tale of 2 towns and a nonprofit
- Kennebunkport- NRDC Report, media, community involvement
- Lincolnville- beyond the shoreline survey, ID and remediation

Bar Harbor Town Beach site

MDIWQC Student Researchers

Marketing Plan

- Strategy Developed w/ Advisory Committee and marketing firm PBK
- Beach User and Municipal Surveys
- Radio spots & PSAs, TV weather line, Radio Forums
- Web Design
- Written materials -distribute 70,000 to Chamber of Commerce, Info Ctrs, park Kiosks, mailed w/ parking permits, etc.



Education & Outreach

>Audience: Local Community Participants and General Public

>Resources: Brochure, Community Guide, Logo, Website, signage, Hotline, GIS Maps

>Format: Beach-User Surveys, Municipal Surveys,Town Mtgs, Beaches Conference, Phone/Email, Newsletters, Press, TV, Radio

For More Information:

- Websites: : www.MaineHealthyBeaches.org
- www.cdc.gov/healthyswimming
- www.epa.gov/ost/beaches
- Hotline for Advisories: 800-232-4733
- Poster/Flyer/Sign: On kiosks/ Lifeguard Stands
- Beach Manager/Park Manager
- UMCE/Sea Grant:Esperanza Stancioff
  377 Manktown Road
  Waldoboro, ME 04572
  Phone: (207) 832-0343 or 1-800-244-2104
  FAX 207-832-0377
  email: esp@umext.maine.edu

Questions and Answers

Q (Richard Haugland, U.S. EPA, Office of Research and Development): Who does the analyses for your voluntary monitoring program? How are the analyses funded?

Esperanza Stancioff

This whole program is funded through EPA Beach Program funds. The program is voluntary in the sense that it is not in some of the personnel's (i.e., lifeguards, state park personnel) job description. We also have some volunteer staff along the coast. However, it the program is not completely voluntary. Four regional labs are used; two are certified, two are not. Of those labs, two use Enterolert and two use Enterolert and membrane filtration.

Q: I had an opportunity to travel in Maine recently, and I was very impressed with the wonderful water resources the state has, especially the Rachel Carlson Reserve, which was wonderful. Have you done any background bacterial monitoring in some of those pristine areas (in Maine)? Also, have you done any water monitoring of urban runoff that might come from that big white house in Kennebunkport?

Esperanza Stancioff

We have been monitoring water quality, looking at bacteria in particular, for 16 years with volunteer support. The reserves in Rachel Carson (pristine) areas have good water quality. We have done a complete study of a large brook that is in one of the "pristine-looking" areas that has very high bacteria counts. So, we are doing a lot of investigative monitoring as well as looking at the beach area.

Incorporating the Bacterial Indicator Enterococci in Marine Beach Water Quality Monitoring Program

Clay Clifton
County of San Diego, Department of Environmental Health

Biosketch

Mr. Clifton is the Recreational Water Program Coordinator for the County of San Diego Department of Environmental Health (DEH). Mr. Clifton received his B.A. in Political Science from Furman University in Greenville, S.C. and M.A. in Marine Affairs and Policy from the Rosenstiel School of Marine & Atmospheric Science at the University of Miami. Mr. Clifton is taking the California Registered Environmental Health Specialist exam in November of this year. He started with DEH as an Environmental Health Technician in 1997 and worked as the sampler for the Recreational Water Program. Mr. Clifton represents DEH at the California Beach Water Quality Work Group, Monitoring and Reporting Subcommittee.

Abstract

In 1986 the EPA published Ambient Water Quality Criteria for Bacteria, which recommended replacing coliforms with enterococci as a better indicator of health risk from fecal contamination in marine waters. In 1999 California implemented AB 411, which added enterococci to coliforms as bacterial indicators for beach monitoring programs. The effect was dramatic for California, which experienced an exponential increase in advisories issued for bacterial exceedances. In San Diego County for example, there were 19 days posted under Advisory in 1998; and 2137 days posted in 2000. The addition of enterococci played a major role 60% of exceedances contained an enterococci exceedance. 91% of advisories caused by a single indicator were attributed to enterococci.

While the increases in advisories caught the attention of the media, state regulators, environmental and stormwater programs, the health departments implementing AB 411 tried to interpret the enterococci data. Officials examined the new indicator data in the context of the coliform data, which they were accustomed to analyzing, in an effort to characterize the relationship between the two.

Four years later health departments have a better understanding of advantages and limitations of enterococci as an indicator of fecal contamination. The enhanced understanding of enterococci and coliforms, much of it verified by research, and the resultant implications for beach monitoring programs can be presented in these categories:

- Characteristics of enterococci and interaction with coliforms
- Importance of auxiliary data in data interpretation
- Actual health risk vs. random noise in bacterial exceedances
- Implications for adaptive monitoring programs

EPA United States Environmental Protection Agency

2004 Beaches Conference

Incorporating Enterococci in beach water monitoring

Clay Clifton
County of San Diego
Department of Environmental Health
Land & Water Quality Division

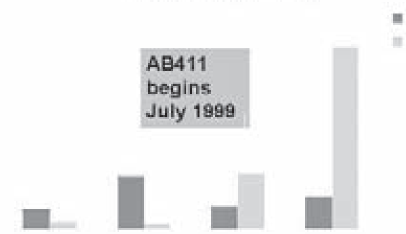
US EPA *Ambient Water Quality Criteria for Bacteria, 1986*

- Recommends replacing coliform bacteria with enterococcus as a better indicator of health risk from fecal contamination in marine waters
- In California, AB411 implemented in July 1999
  - Single Sample Standards for TC, FC, Ent
  - Enterococci 104 per 100mL

MANDATORY

Results of implementing AB411…

Perception of deteriorating water quality



Exceedances of single sample standards Apr - Oct, 2000

- Of exceedances caused by one indicator only, 91% were Enterococci
- Of exceedances caused by more than one indicator, 60% had Enterococci
- 23% of exceedances attributed to Total and/ or Fecal Coliform *without* Enterococci

Confirmation of contamination (or lack thereof)

- In 136 (76%) of the 178 Advisories issued by DEH between April and October, the follow-up sample was within single sample standards for all indicators

Issues with implementing AB411

- Beaches are usually posted with:

1. Lack of indicator agreement
2. Lack of confirmation in follow-up samples

Is enterococci a good indicator of sewage contamination?

	TC	FC	Ent
●sample 1	>16000	>16000	>12000
●sample 2	900	500	300
●sample 3	9000	300	324
●sample 4	5000	3000	207

Unknown source exceedances

	TC	FC	Ent
●sample 1	1100	1100	20
ple 2	1300	1300	10
ple 3	130	40	364
le 4	< 20	< 20	624

Aids in data interpretation

Knowledge of site/ beach

- Watershed land uses
- Sewer infrastructure condition
- Wildlife populations
- Coastal outlet flows (e.g., storm drains, river mouths)

Data interpretation, cont'd

Sample field observations

1. Time (UV radiation)
2. Tide
3. Current direction
4. Last rainfall
5. Numbers of wildlife or bathers
6. Coastal outlet flowing to ocean

So… interpret the data

Two beach types defined in southern California:

1. High risk: adjacent to coastal outlets and/ or enclosed bays with poor circulation
2. Low risk: open coast

- High risk beaches most likely to exceed the 30-day log mean standard for enterococcus – require adaptive sampling

Adaptive sampling

Routine

1. Sample high risk beaches at higher frequency

Follow-up

1. Time of day
2. Tide
3. Currents
4. Multiple (spatial / temporal) samples

Well, that was great! Let's go sample some beaches!

WAIT ! .....there are LIMITATIONS or shortcomings with the indicators!

The bacterial indicator monkey wrench

- Health risks from non-human sources in recreational waters are not fully determined

The bacterial indicator monkey wrench, cont'd.

Environmental replication of enterococci and fecal coliform

- A NZ study found entero and fecal coliform levels in decaying seagrass up to 900x higher than adjacent seawater
- Indicator bacteria associated with biodegradation
- FC and Ent are able to replicate in a growth permissive environment

Local studies

- Mission Bay and San Diego River outlet
  1. Sediments, wrack line, and drains act as bacteria reservoirs
  2. Replication of bacteria on organic matter in storm drains
- Cal Trans study of pathogens in storm drain discharges
  1. Pathogens detected in 12 of 97 samples
  2. No correlation between indicator levels and pathogens

Conclusions, part 1

- 30-day log mean standard is better public health protection tool than the single sample standard
- Posting using a single sample standard should require confirmation:
  1. Multiple indicators, OR
  2. Follow-up sample

Conclusions, part 2

- Adaptive sampling is needed to obtain representative samples
- Non-anthropogenic sources can enable replication of coliforms and enterococci. What is health risk?

Endnotes

1. Title 17, Group 10. Sections 7958 – 7961. California Code of Regulations. Developed by the State of California Department of Health Services.
2. County of San Diego, Department of Environmental Health, Land & Water Quality Division, Recreational Water Program. San Diego, California.
3. Noble R, M. Leecaster, C. McGee, D. Moore, V. Orozco-Borbon, K. Schiff, P. Vainik, S. Weisberg. Southern California Bight 1998 Regional Monitoring Program, Vol 3: Storm Event Shoreline Microbiology. Southern California Coastal Water Research Project. Westminster, California.
4. Cabelli, V.J. 1983. Health Effects Criteria for Marine Waters. EPA-600/1-80-031, US Environmental Protection Agency, Cincinnati, Ohio.
5. Boehm A., J. Fuhrman, R. Mrse, S. Grant. Tiered Approach for Identification of Human Fecal Pollution Source at a Recreational Beach: Case Study at Avalon Bay, Catalina Island, California. Environ. Sci. & Technol. Vol. Xx No. xx, xxxx.

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7. Boehm A.B., S. Grant, J. Kim, L. Mowbray, C. McGee, C. Clark, D. Foley, S. Wellman. Decadal and Shorter Period Variability of Surf Zone Water Quality at Huntington Beach, California. Environmental Sci & Tech. Vol 36, No 18, 2002.
8. Un-published findings of the Beach Water Quality Workgroup, Monitoring & Reporting Subcommittee. California State Water Resources Control Board.
9. US EPA Office of Water. Implementation Guidance for Ambient Water Quality Criteria. November 2003 Draft. EPA-823-B-03-XXX. US Environmental Protection Agency, Washington, D.C.

Endnotes 3

10. S.A. Anderson, S.J. Turner, G.D. Lewis, Enterococci in the New Zealand Environment: Implications for Water Quality Monitoring. Wat. Sci. Tech. Vol. 35, No 11-12. 1997.
11. Byappanahalli M., M. Fowler, D. Shively, R. Whitman. Ubiquity and Persistence of Escherichia coli in a Midwestern Coastal Stream. Applied and Environmental Microbiology, Vol. 69, No. 8. 2003.
12. Mission Bay Bacterial Source Identification Study, Sept 2004. San Diego River – Ocean Beach Water Quality Improvement Project, Sept 2003. Prepared by MEC-Weston Solutions, Inc. and the City of San Diego. Prepared for California State Water Resources Control Board.
13. Schroeder E, M. Stallard, D. Thompson, F. Loge, M. Deshusses, H. Cox. Management of pathogens associated with storm drain discharge. Document No.43A0073 Prepared for CalTrans Division of Environmental Analysis by the Center for Environmental and Water Resources Engineering, UC Davis 2002.

Questions and Answers

Q: Which pathogens did the CalTrans study find?

Clay Clifton
Adenovirus and *Salmonella* were found. I think the report is online.

Comment: I would be quite concerned with Shigella.

Clay Clifton
Yes, *Shigella* would be an indication of human presence.

Comment: You also mentioned that there was no correlation with pathogen and indictor levels. That would not necessarily be expected, but you would get worried when you have pathogens there but no indicators.

Clay Clifton
Yes, this case occurred in samples taken at the Tijuana River mouth. There was a presence of an enterovirus with no associated indicators. That is a problem. But, what is equally concerning to me is if there is no correlation between pathogens and indicators. We are working under the presumption that the indicators will tell us if there is a quantifiable health risk. But, if the pathogens do not correlate to the indicators, that is a limitation.

Q: You are using a fecal coliform/total coliform ratio. I am an epidemiologist, and to my knowledge that ratio has not been linked to any health effect in any of the literature, except for one study based on storm water. In addition, total coliform is known to multiply. Who made the decision to use that ratio or total coliforms as an indicator for health when there is little indication that it is a good indicator of health?

Clay Clifton
My understanding is that the total/fecal ratio was based upon the findings of the Santa Monica Bay epidemiological study. The California Department of Health Services wrote the bacterial standards in the California Code of Regulations. In developing those standards, they used the findings of the Santa Monica Bay study, which was the one that looked at surface runoff impact on beaches.

Q (Shannon Briggs, Michigan Department of Environmental Quality): In Michigan we have a 30-day and a daily standard. One of the frustrations we have is that you can exceed one standard and not the other. It's easier to get a better confirmation with the 30-day standard, if you have a lot of data over a 30-day period. However, what can be done if the 30-day average is high because there were high levels earlier in the month, but you have low counts today, it has not rained, and you think you have a really good beach situation? How do you deal with that situation, especially since we are trying to go to real-time results? Do you have a policy on that?

Clay Clifton
Yes, we are trying to get the protocol for the use of the 30-day log mean worked up right now. What I would do is track the 30-day log mean for Enterococcus, since that will most likely be the only one that will ever exceed the standard at any beach. Then, front end-load that 30-day log mean by taking multiple samples the week that you want to make the decision. For example we have beaches with chronic water quality problems that have high bacteria levels coming from multiple sources. In the course of 30 days, we could get two enterococcus sample results that are

less than 10 cfu. But, I'm not going to lift the advisories in those cases because if I go out and get a third sample, it will probably be 400 cfu or even 3000 cfu. So, I look at the 30-day log mean. I see that my most distant time sample has 400 cfu, and I see a decreasing trend in the week I am in now, which has one clean (single) sample. So, I would want to take at least one more sample that week so that my 30-day log mean becomes front end-loaded and I'd be weighing it more towards the more recent data and then only counting one sample per other sample event going back to the 30-days.

Comment: So, you weigh your 30-day mean a little bit? You do not take it as an all-inclusive 30-day pile of data?

Clay Clifton

I have tried to come up with a procedure to address it. I would take the highest bacteria sample result per sample event per day and take all the data from the last 30 days. Then, when you are coming up to that decision point where it looks like you are coming out of the contamination event, collect more samples during that week so that you have more recent data points to use to front-end load your 30-day mean.

Q: (Rachel Noble): We're seeing similar trends with enterococcus. Do you have an idea of any kind of enterococcus speciation that was done on any of the samples? What species are found in the soil and plant samples—and are they available to be analyzed?

Clay Clifton

I saw a New Zealand study that found that *E. facium* and *E. faecalis* were the most common species of enterococci. That suggests there is a human source. But if there is replication in the environment, do we still have the associated health risk? If the indicator bacteria from a human source replicates, do the associated pathogens also replicate? I'm not aware that a virus particle can replicate outside of a host.

Q: Were E. facium *and* E. faecalis *in your wrack samples, as well as the plant and soil samples?*

Clay Clifton

It is uncertain. The City of San Diego told me during a conversation with their microbiologist that *E. facium* and *E. faecalis* were the most common, but it was not particular to the two studies I just mentioned. It was a more general observation.

Comment (Stephan Weurtz, University of California Davis): I was on the advisory committee for the CalTrans study. The study found pathogens when no indicators were found. Pathogens included adenoviruses and enteroviruses. They were detected using molecular techniques with no test for viability. They were totally unrelated with the presence of indicators.

Washington State's Beach Environmental Assessment, Communication and Health (BEACH) Program

Lynn Schneider
Washington State Department of Ecology

Biosketch

Lynn Schneider is the BEACH Program Coordinator for the State of Washington. The BEACH Program is a managed jointly by the State Departments of Ecology and Health. Because of the joint management, she splits her time between the two agencies.

Ms. Schneider received her B.S. in Environmental Chemistry from the Evergreen State College in Olympia, Washington in 1988. She worked as a chemist for Morton International for eight years prior to joining the Washington State Department of Ecology in 2001. Lynn became the BEACH Program Coordinator in 2001. Her main interest is the relationship between increases in indicator levels and increased illness rates associated with water contact and how increased risk is communicated to the public.

Abstract

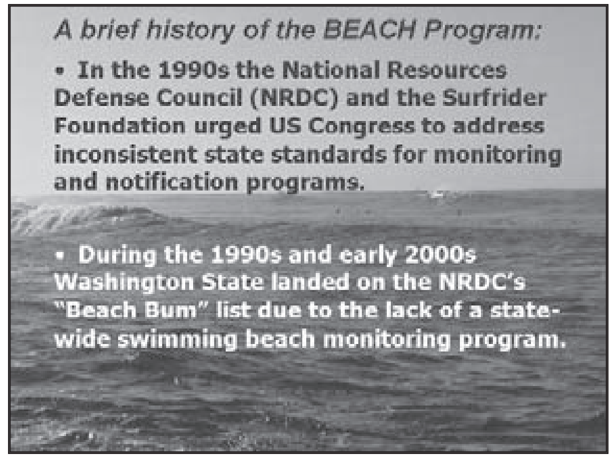
Washington State's Beach Environmental Assessment, Communication, and Health {BEACH} Program began in 2002. An inter-agency BEACH Committee was established to develop program guidelines. The BEACH Program was implemented as a pilot project during 2003 in five counties. Full implementation to Washington's fourteen coastal counties with marine beaches began in 2004.

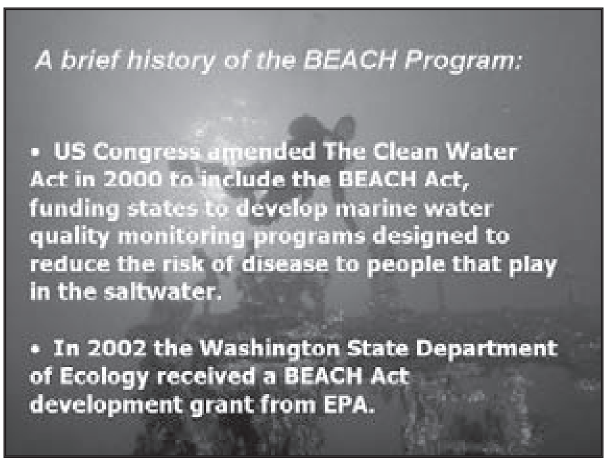
Washington's BEACH Program is completely funded through federal BEACH Act funds. The Program is a collaborative effort between state, county and local agencies, tribal nations, and volunteer organizations. Washington State has over 3000 miles of coastal waters with over 650 public recreational beaches. Using a matrix designed to prioritize beaches according to risk, 72 beaches were identified as Tier 1 beaches. Due to limited funding, Tier 2 beaches were not included in the 2004 sample plan.

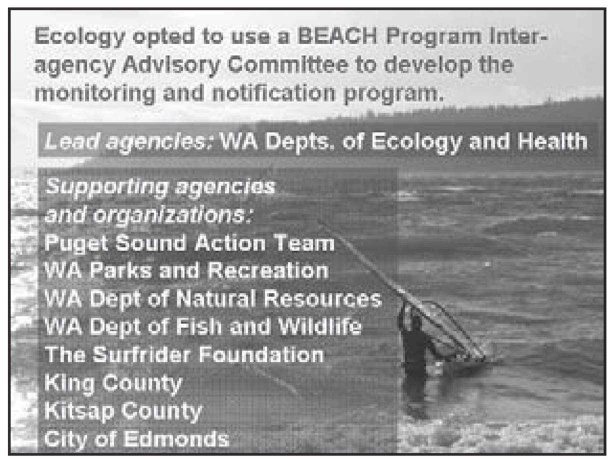
The Program is able to maximize the number of beaches being monitored by allowing counties to design sample collection plans best suited to their resources. Six counties use environmental health staff to collect the samples. Two use county staff supplemented by volunteers when available. Four are sampled completely by volunteers. One tribal nation is collecting samples. One county is sampled using state employees. One county did not have a Tier 1 beach.

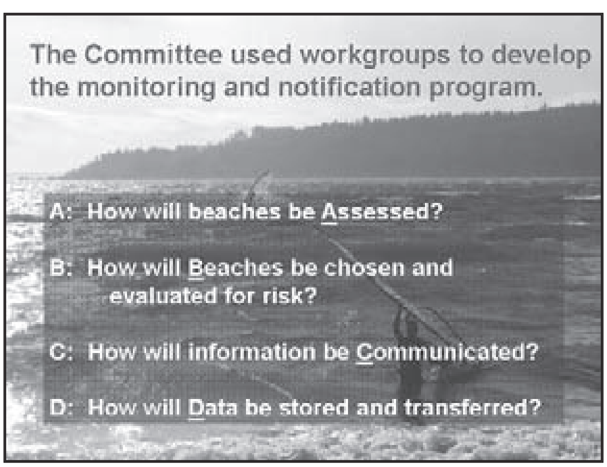
Three samples are collected across the beach and are analyzed by state accredited labs within six hours of sample collection. Results are e-mailed or faxed within 24 hours. The three samples are averaged and then compared to threshold limits. Geometric means are calculated using all the sample results from the five previous weeks. Advisories are posted on the BEACH Web within 24 hours, all sample results within 48 hours of arrival at the Department of Ecology.

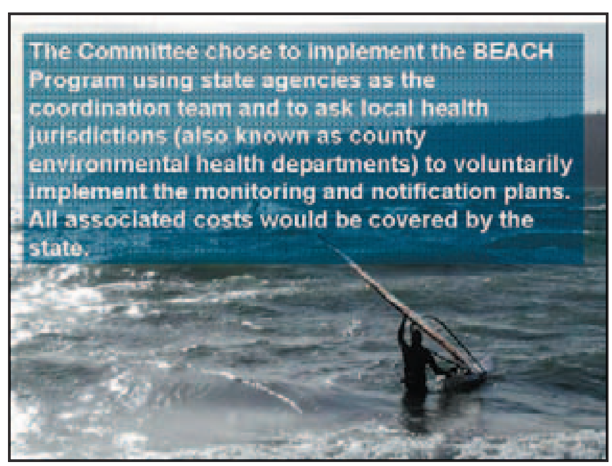

Beach Environmental Assessment, Communication, and Health Program

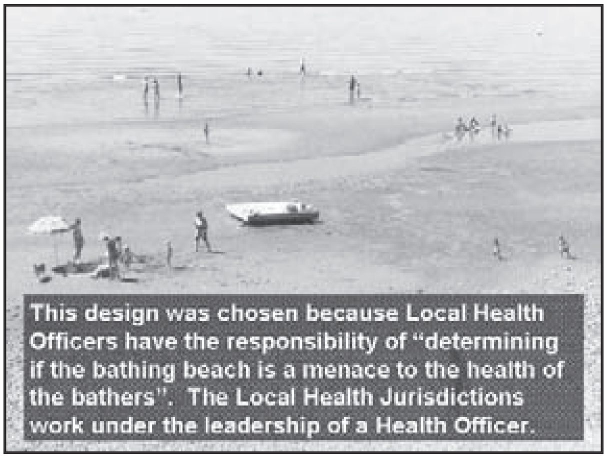

A brief history of the BEACH Program:
• In the 1990s the National Resources Defense Council (NRDC) and the Surfrider Foundation urged US Congress to address inconsistent state standards for monitoring and notification programs.
• During the 1990s and early 2000s Washington State landed on the NRDC's "Beach Bum" list due to the lack of a state-wide swimming beach monitoring program.

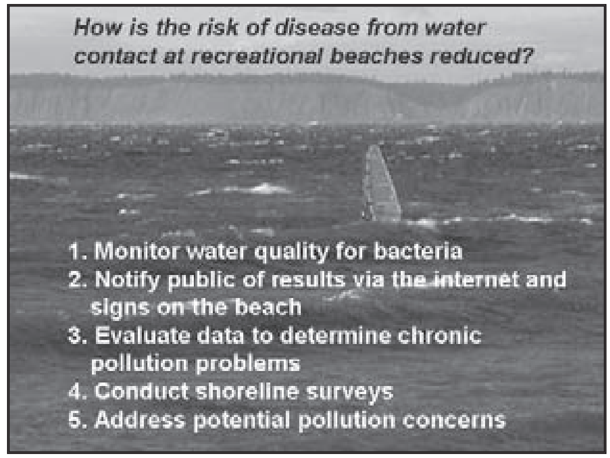

A brief history of the BEACH Program:
• US Congress amended The Clean Water Act in 2000 to include the BEACH Act, funding states to develop marine water quality monitoring programs designed to reduce the risk of disease to people that play in the saltwater.
• In 2002 the Washington State Department of Ecology received a BEACH Act development grant from EPA.

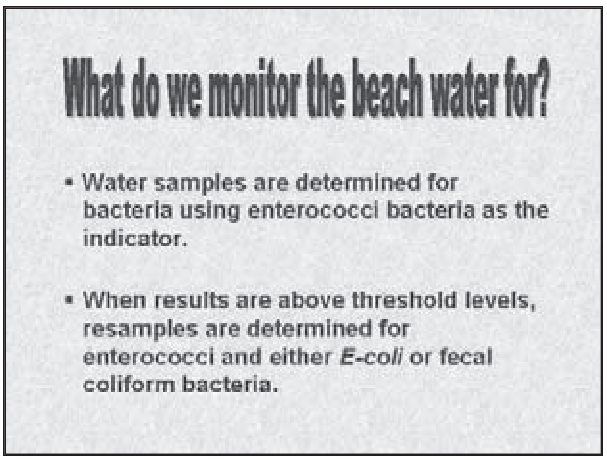

Ecology opted to use a BEACH Program Inter-agency Advisory Committee to develop the monitoring and notification program.
Lead agencies: WA Depts. of Ecology and Health
Supporting agencies and organizations:
Puget Sound Action Team
WA Parks and Recreation
WA Dept of Natural Resources
WA Dept of Fish and Wildlife
The Surfrider Foundation
King County
Kitsap County
City of Edmonds


The Committee used workgroups to develop the monitoring and notification program.
A: How will beaches be Assessed?
B: How will Beaches be chosen and evaluated for risk?
C: How will information be Communicated?
D: How will Data be stored and transferred?

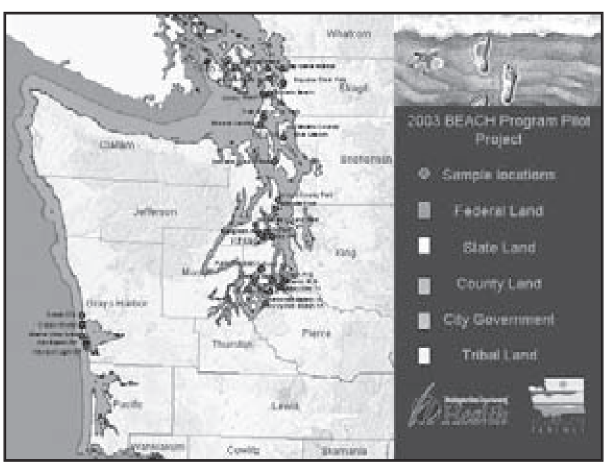

The Committee chose to implement the BEACH Program using state agencies as the coordination team and to ask local health jurisdictions (also known as county environmental health departments) to voluntarily implement the monitoring and notification plans. All associated costs would be covered by the state.


This design was chosen because Local Health Officers have the responsibility of "determining if the bathing beach is a menace to the health of the bathers". The Local Health Jurisdictions work under the leadership of a Health Officer.

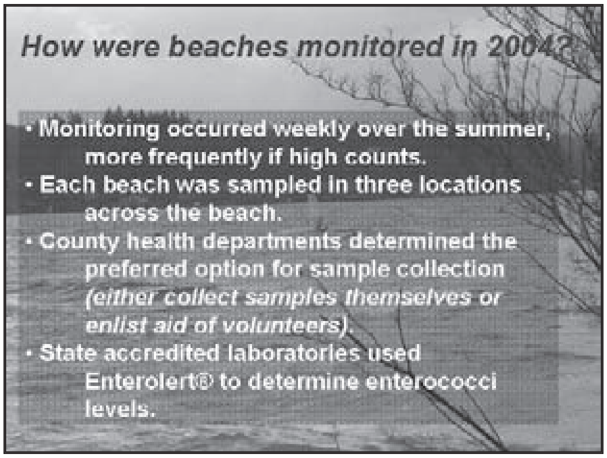

How is the risk of disease from water contact at recreational beaches reduced?
1. Monitor water quality for bacteria
2. Notify public of results via the internet and signs on the beach
3. Evaluate data to determine chronic pollution problems
4. Conduct shoreline surveys
5. Address potential pollution concerns

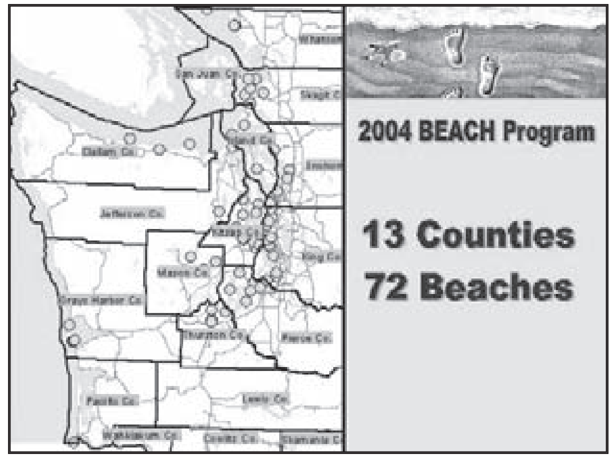

What do we monitor the beach water for?
▪ Water samples are determined for bacteria using enterococci bacteria as the indicator.
▪ When results are above threshold levels, resamples are determined for enterococci and either E-coli or fecal coliform bacteria.

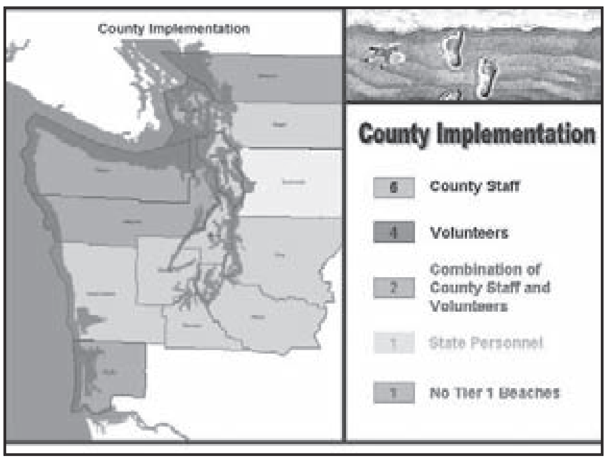

2003 Implementation
5 Counties participated in a Pilot Program.
42 beaches were monitored for enterococci and either fecal or E. coli.

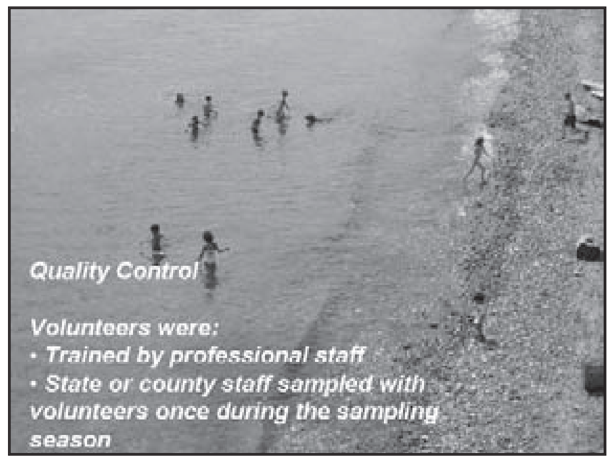

Whatcom
Skagit
Clallam
Snohomish
Jefferson
King
Grays Harbor
Thurston
Pierce
Pacific
Lewis
Wahkiakum
Cowlitz
Skamania
2003 BEACH Program Pilot Project
Sample locations
Federal Land
State Land
County Land
City Government
Tribal Land

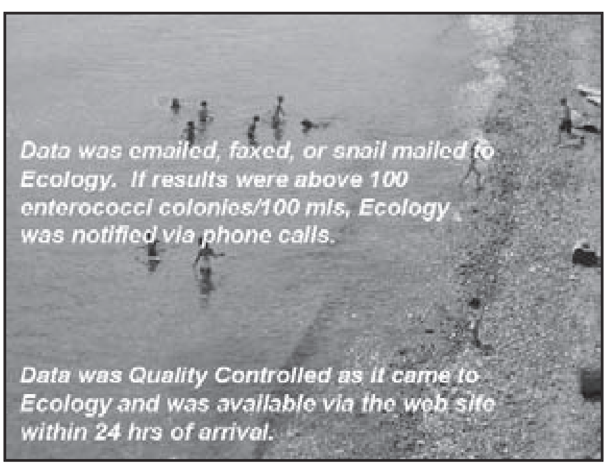

2004 Program Implementation

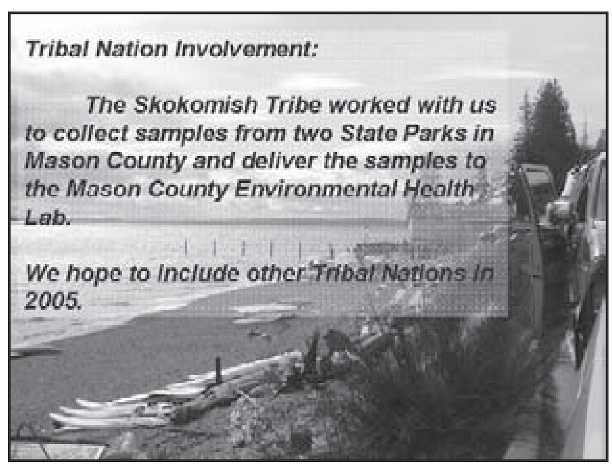

How were beaches monitored in 2004?
• Monitoring occurred weekly over the summer, more frequently if high counts.
• Each beach was sampled in three locations across the beach.
• County health departments determined the preferred option for sample collection (either collect samples themselves or enlist aid of volunteers).
• State accredited laboratories used Enterolert® to determine enterococci levels.

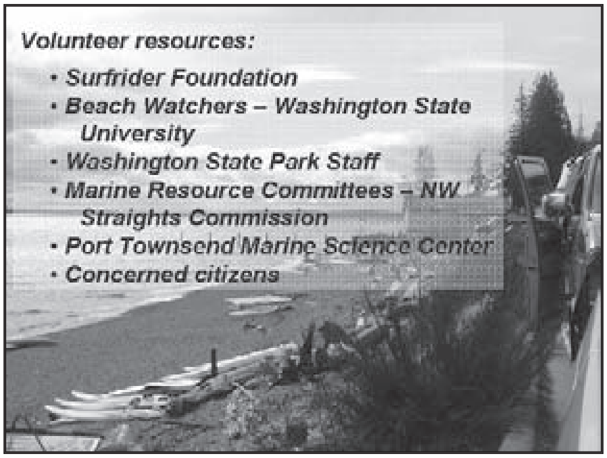

2004 BEACH Program
13 Counties
72 Beaches

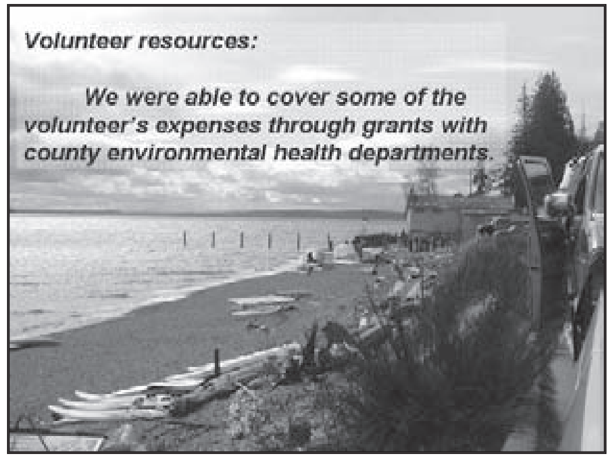

County Implementation
County Implementation
6 County Staff
4 Volunteers
2 Combination of County Staff and Volunteers
1 State Personnel
1 No Tier 1 Beaches

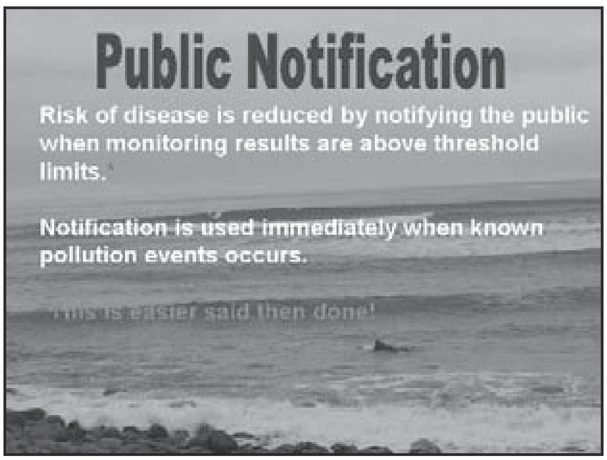

Quality Control
Volunteers were:
• Trained by professional staff
• State or county staff sampled with volunteers once during the sampling season

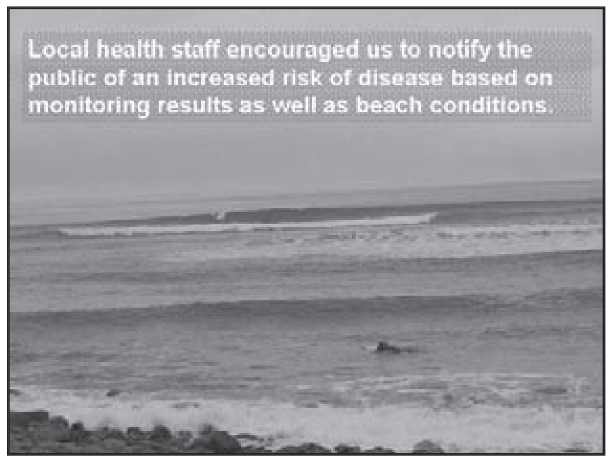

Data was emailed, faxed, or snail mailed to Ecology. If results were above 100 enterococci colonies/100 mls, Ecology was notified via phone calls.
Data was Quality Controlled as it came to Ecology and was available via the web site within 24 hrs of arrival.

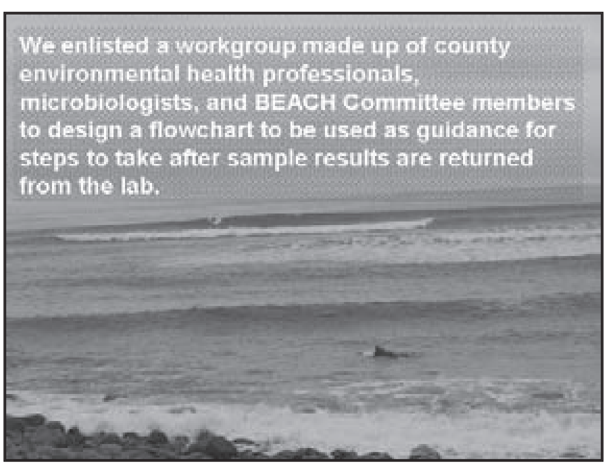

Tribal Nation Involvement:
The Skokomish Tribe worked with us to collect samples from two State Parks in Mason County and deliver the samples to the Mason County Environmental Health Lab.
We hope to include other Tribal Nations in 2005.

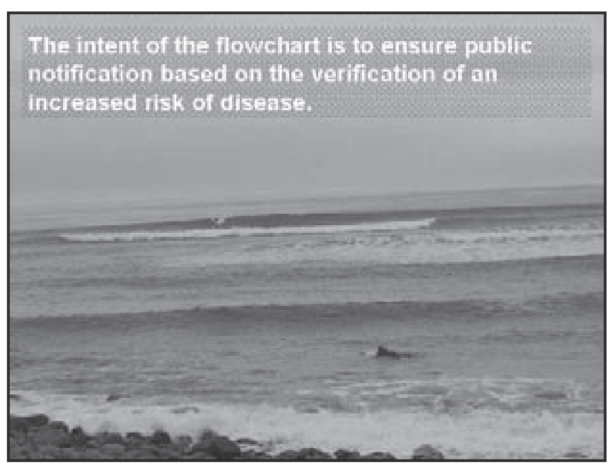

Volunteer resources:
• Surfrider Foundation
• Beach Watchers – Washington State University
• Washington State Park Staff
• Marine Resource Committees – NW Straights Commission
• Port Townsend Marine Science Center
• Concerned citizens

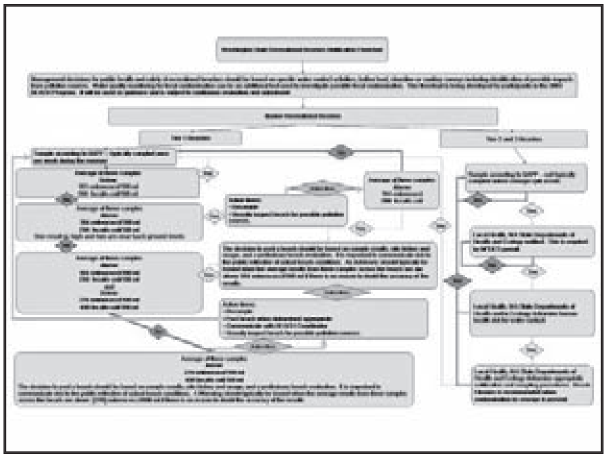

Volunteer resources:
We were able to cover some of the volunteer's expenses through grants with county environmental health departments.


Public Notification
Risk of disease is reduced by notifying the public when monitoring results are above threshold limits.
Notification is used immediately when known pollution events occurs.
This is easier said then done!


Local health staff encouraged us to notify the public of an increased risk of disease based on monitoring results as well as beach conditions.


We enlisted a workgroup made up of county environmental health professionals, microbiologists, and BEACH Committee members to design a flowchart to be used as guidance for steps to take after sample results are returned from the lab.


The intent of the flowchart is to ensure public notification based on the verification of an increased risk of disease.




Please contact us with questions or suggestions.
http://www.doh.wa.gov/beach
Lynn Schneider,
WA State Departments of Ecology and Health
Jan Newton,
WA State Department of Ecology
Jessica Archer,
WA State Department of Ecology


Questions?

Questions and Answers

No questions.

Wednesday, October 13

1:20 p.m. – 2:50 p.m.

Session Three: Design of Beach Monitoring Programs

EPA Overview: Current National Requirements, Guidance and Hot Issues

Matthew Liebman
U.S. Environmental Protection Agency, Region 1

Biosketch

Mr. Liebman is the Environmental Biologist at the U.S. Environmental Protection Agency New England regional office in Boston, MA. Mr. Liebman received his B.A in Biology in 1980 from Carleton College in Minnesota and a Ph.D. in Ecology and Evolution from the State University of New York at Stony Brook in 1991. Since 1990, he has worked at the EPA office in Boston as a project manager and scientist in the National Estuary Program, dredged material disposal and monitoring program, and as a water quality specialist. He is the regional coordinator for EPA's BEACH program, nutrient criteria initiative and national sediment inventory. At EPA, Mr. Liebman has conducted or been involved in research efforts in dredged material disposal site monitoring, and impacts of nutrients and bacteria on water quality in streams, coastal waters and beaches.

Abstract

This presentation will provide an overview of EPA's recommendations for monitoring beaches contained in the Beach Grant Performance Criteria document. EPA recommends that states develop a tiered monitoring plan so that beaches with higher use and more pollution sources (hence higher risks), be monitored more frequently. To classify beaches based on risk, state and local health officials should characterize water quality and pollution sources at each beach. EPA recommends that both the geometric mean (for long term exposure) and the single sample maximum (for daily observations) be used to notify the public that bacteria levels exceed acceptable health-based risk levels. EPA's recommendations for appropriate bacteria indicators and health-based thresholds for public notification stem from important epidemiological studies conducted in the 1970s and 1980s. These thresholds have been corroborated by more recent epidemiological studies. There is still, however, a central challenge in bacteria monitoring at beaches -- that elevated levels of bacteria are variable and intermittent, and that traditional analyses of bacteria take at least 24 hours, after the public has been exposed. As a result, questions such as how frequent to sample, and whether the geometric mean is a useful threshold are still being debated. Recent research conducted by EPA and others have demonstrated approaches to deal with these and other related issues, some of which will be reported on in this session.

EPA Overview: Current National Requirements, Guidance and Hot Issues

Matthew Liebman
US EPA New England

EPA National Beaches Conference, San Diego, CA   October 13, 2004   EPA

Recent History of Beach monitoring and management recommendations: the Rock'n 70s and 80s

- National Technical Advisory Committee to FWPC (1968) and EPA Quality Criteria for Water (1976) – recommends fecal coliform at 200 and 400 cfu/100 ml
- Health Effects Criteria for Freshwater and Marine Waters 1979 and 1983 – prospective epidemiological studies establishes relationship between enterococci and *E. coli* and illness rates
- Ambient Water Quality Criteria for Bacteria (1986) – sets criteria based on risk of illness

EPA National Beaches Conference, San Diego, CA   October 13, 2004   EPA

Recent History of Beach monitoring recommendations: the bridge to the 21st century

- Health-Based Monitoring of Recreational Waters: The Feasibility of a New Approach "The Annapolis Protocol" (1999) – established tiered monitoring approach
- Haile et. al., Health effects of swimming in ocean water contaminated by storm drain runoff (1999, Santa Monica Bay epi study) – this and other studies corroborated EPA epidemiological studies and correlated to non-point sources
- Draft implementation guidance for ambient water quality criteria for bacteria (May 2002) – synthesized literature
- Performance Criteria for Beach Act June (2002) – provided concise sampling guidance, incorporated tiered monitoring approach
- EPA Recreational Beach Monitoring Guidance: Topics and Recommendations, Draft 2004 – provided guidance based on statistical monitoring in EPA EMPACT Beaches project 2001- 2002 (Wymer et al., 2003)

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Key 1986 Bacteria criteria recommendations

- Change indicator from fecal coliform to enterococci for marine, and enterococci or *E. coli* for freshwater
- Use the ***geometric mean*** over a 30 day period, based on (at least) five equally spaced (weekly) samples -- represents exposure related to the study design (long term exposure) (re-iterated recommendations from NTAC and EPA 1976)
- Statistically based ***single sample maximum*** used to close (or re-open) or post an advisory -- represents an increased risk of illness, ***that the exposed water is likely to exceed the geometric mean threshold with a certain level of confidence***
- Sample in three feet of water, one foot depth (i.e. two feet above bottom) (although EPA epi studies at waist to chest depth, about 3 to 4 feet for an adult)

EPA National Beaches Conference, San Diego, CA   October 13, 2004   EPA

Appropriate threshold values used to post advisories for marine recreational waters

- Principle: *Enterococci* geometric mean standard equivalent to similar "acceptable" level assumed for 200 fecal coliform limit, which correlates to 19 GI illnesses per 1000 swimmers
- Geometric mean: 35 CFU or MPN/100 ml based on at least 5 samples for the previous 30 days
- Single sample: 104 CFU or MPN/100 ml, based on a standard deviation of 0.7, but could use a site-specific standard deviation
- *This represents an increased risk level, i.e. the levels of bacteria in the water are likely to be greater than the acceptable geometric mean value of 35 per 100 ml*

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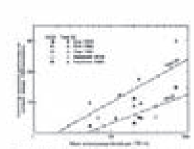
Important aspects of the design of EPA prospective epidemiological studies

- Study design included clusters of days with similar water quality
- Each day was sampled 3 to 4 times, between 11 am and 4 pm in areas of high use
- Most sites were influenced by combination of point and non-point sources
- Swimmers exposed once (i.e. on one day) and followed for nine days



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Annapolis Protocol and Performance Criteria:
Design a Tiered-monitoring program based on risk

- Characterize your beach's water quality patterns, determine what influences changes in bacteria concentrations
  - tides
  - water currents
  - rain
  - potential sources – e.g. WWTP, CSOs, human and non-human sources, storm water pipes, boats, wrack, seepage
- Address frequency and location of monitoring and assessment of waters based on:
  - pollution sources
  - extent and frequency of recreational use
  - proximity to and effects of point and non-point pollution sources on water quality
- Classify into Tiers and design monitoring scheme

EPA National Beaches Conference, San Diego, CA — October 13, 2004 — EPA

Tier 1 beaches

EPA National Beaches Conference, San Diego, CA — October 13, 2004 — EPA

Recommendations from Performance Criteria for a Tiered Sampling Design

- When to conduct routine sampling:
  - Tier 1 - more than once per week (high probability that a standard is exceeded, and/or use is high)
  - Tier 2 – one time per week (low to moderate probability)
  - Tier 3 – minimum sampling frequency (very low probability)
- When to re-sample:
  - Resample after a standard is exceeded, but may not post an advisory if a sample's accuracy is doubted
  - After a sewage spill or pollution event
  - Reopening after an advisory or closure to determine if the plume has diminished
  - After a significant rainfall event
- Where to collect samples:
  - Mid beach, every 500 meters if a long beach, near pollution sources, stratify if necessary
- What depth to sample:
  - Knee depth

EPA National Beaches Conference, San Diego, CA — October 13, 2004 — EPA

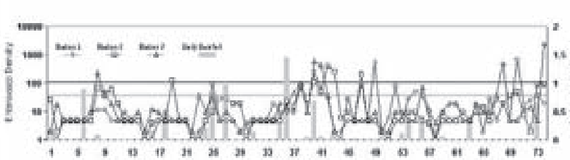
Results from recent (and not so) research that challenge our traditional approaches and improve our ability to monitor water quality at beaches

- Elevated levels of bacteria are transitory or intermittent; exposure on day 1 does not reflect exposure the following day
- Rainfall can be used with some confidence to predict likelihood of bacteria counts exceeding a standard
- Elevated indicator bacteria densities in the surf zone or shallow water (influence of sediment sources of bacteria)
- Elevated indicator bacteria densities in morning (ultraviolet radiation kills off some bacteria)
- Clonal populations of *E. coli* from non-point sources, not human sources

EPA National Beaches Conference, San Diego, CA — October 13, 2004 — EPA

Example of monitoring results that challenge beach managers
(Data courtesy of MWRA and MDC)

Boston Harbor Beach, Summer 2000, Daily Sample Results



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Questions raised (i.e Hot Issues)

- There's no real time monitoring yet! So, what is the value of managing a beach based on a Single Sample Maximum threshold if a bacteria plume typically last less than one or two tidal cycles, and that a posting occurs over 24 hours after exposure?
- How reliable is one sample to characterize water quality at the whole beach, for the whole day?
- Given analytical and ambient variability, how would apply one sample if result is close to the thresholds
- How frequently should we sample at a Tier 1 beach? Should this be based on the likelihood that a sample exceeds a geometric mean or single sample standard?
- Should we sample at low tide or high tide, or in the surf zone or at a deeper depth?
- Should we composite samples to better characterize the water quality, and if so, should we apply the geometric mean or single sample standard?

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Where should we sample? Waist depth?

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How many samples do you need to take to characterize variability at a beach?

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More hard questions

- Does the geometric mean have any value if we sample once per week? -- although the geometric mean doesn't tell you what the conditions are for a single day, is it a good predictor of the probability of exceeding the single sample standard?
- If we know the likelihood that a standard is exceeded, how frequently should we sample to detect, with some level of confidence, these exceedances?
- If a beach manager has funds to analyze four samples per beach per week, should he or she sample on four separate days, or on one day four times, or in four places?

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Conclusions
with apologies to Michael Feldman

These questions have been intensively researched; the answers, however, have not. Until Now.

Enjoy the talks!

EPA National Beaches Conference, San Diego, CA   October 13, 2004   EPA

Questions and Answers

No Questions.

Public Health Protection at Marine Beaches: A Model Program for Water Quality Monitoring and Public Notification

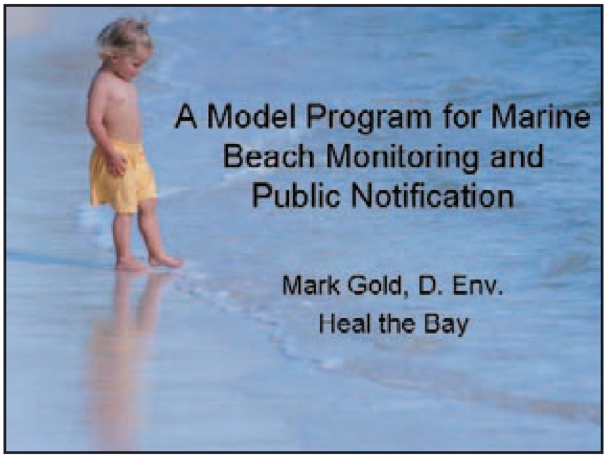
Mark Gold, D.Env.
Heal the Bay

Biosketch

Mark Gold, D.Env., is Heal the Bay's Executive Director. Heal the Bay is an environmental group dedicated to making Santa Monica Bay and Southern California coastal waters safe and healthy for people and marine life. Dr. Gold's extensive work with water quality and coastal natural resource topics ranges from sewage treatment, contaminated sediments, legislative and environmental education issues to urban runoff, contaminated fish and wetland restorations. In 1996, working in conjunction with the Santa Monica Bay Restoration Project and the USC Medical Center, he was a co-author of the first epidemiological study of swimmers in runoff-polluted water. He also has co-authored several stormwater, contaminated fish and beach water quality bills and ordinances, and he created Heal the Bay's Beach Report Card®. He is a vice-chair of the Santa Monica Bay Restoration Commission, sits on the State Water Board's Clean Beach Advisory Group and served on the EPA's Urban Wet Weather Federal Advisory Committee. Dr. Gold also was appointed to the California Ocean Trust. Dr. Gold has bachelor's and master's degrees in biology from UCLA, and he received his doctorate from UCLA in environmental science and engineering in 1994.

Abstract

Heal the Bay authored a guidance document, designed as a national model for routine water quality monitoring and public notification programs for marine beaches. Public awareness regarding beach water pollution and concern about swimming-related illnesses has increased, and attention to beach water quality has led to new legislation (the federal BEACH bill for example) and research on beach water quality issues. In turn, new regulations and an improved understanding of beach pollution have provided impetus for beach managers and local health agencies around the country to modify and expand their existing beach water quality programs. The model program is a tool for local and state health agencies and beach managers to develop and improve marine beach water quality monitoring and public notification programs. Currently, in most of the country, programs vary from state to state and even from county to county within states. The end result is that public health is not always adequately protected, and monitoring results are not comparable from state to state. The intent of the model program is to improve the efficiency and protectiveness of beach monitoring programs outlined in the U.S. EPA's existing guidance. This model program explicitly provides a risk-based rationale and scientific basis for many of the recommended protocols. We hope the model program will help promote consistency in monitoring and public notification programs implemented across the country.



Why develop a Model Program?

Improve public health protection:

- Provide a tool for beach managers to improve existing programs or develop new ones
- Promote consistency across programs
- Enhance guidance provided by U.S. EPA

Model Program Development

5 Guiding Design Principles

- Main goal: Protect public health
- Primary measure of water quality: FIBs
- M&PN protocols based on risk
- Monitoring protocols are conservative
- Public notification protocols are tiered based on risk, instead of binary system of open/closed

Model Program Development

Factors complicating Recreational Beach Risk Management:

- Uncertainty associated with using a non-specific indicator
- Large variability in bacteria indicator densities
- Lag-time from sample collection to public notification

Model Program Structure

Six components:

1: Goal & objectives
2: Recommended FIB standards
3: Prioritization of Beaches by Risk
4: Monitoring
5: Public Notification
6: Public Education

Model Program Objectives

- Main Goal: Protection of Public Health
- Develop specific management and scientific objectives to support main goal
- **Explicit development critical to ensure connection between data collected and agency/stakeholder expectations
- Recommend use of Bernstein's hierarchical methodology, (Bernstein, 1993)

FIB Measurements

- Recommend use of 3 indicators: enterococcus, fecal, total coliform
- T/F ratio provided strongest associations with risk in SM Bay epi. study

Beach Classification by Risk

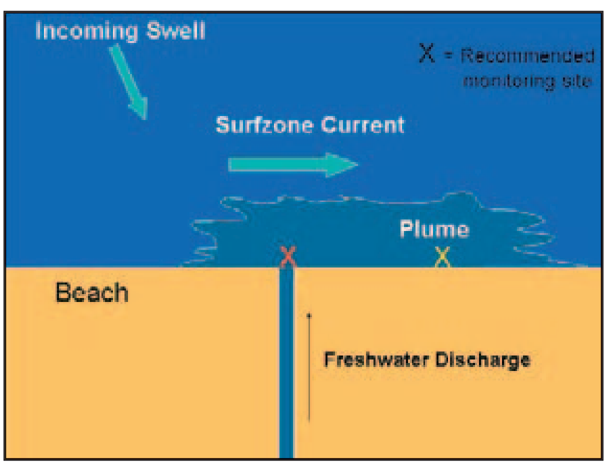
- 3 tiers
- Based on qualitative risk analysis
- Specific recommendations:
  - High risk: beaches w/freshwater discharges, enclosed beaches, beaches w/potential fecal sources
  - Risk category may be seasonal

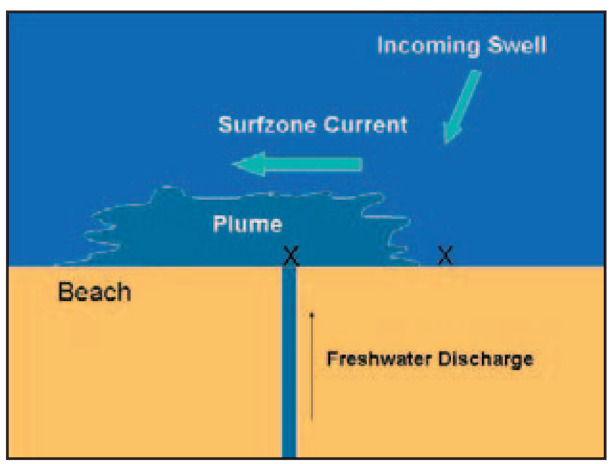
Monitoring

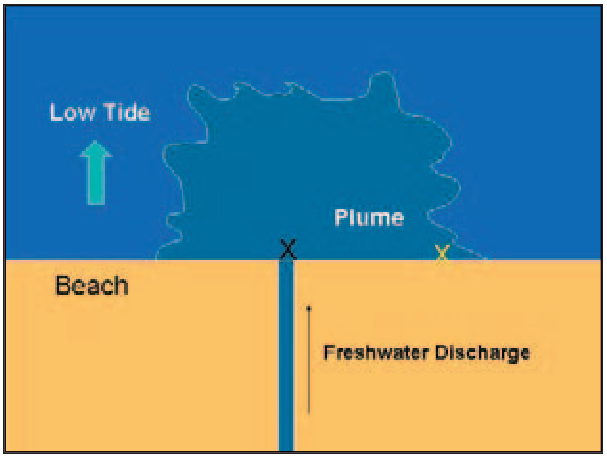
Conservative monitoring strategy: Sample at known or potential source locations in areas and times of highest expected FIB densities:

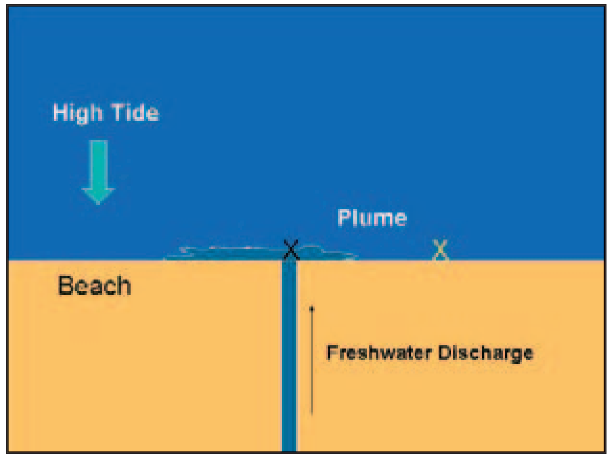
- Ankle-depth
- Directly at known or potential sources
- Freshwater discharges – point zero
- Enclosed beaches – points of lowest circulation

Ankle Depth Monitoring









Monitoring

- Minimum required frequency: Weekly
- Beaches monitored less than weekly:
  - Notify public that beach is not monitored
  - Strive to get resources to monitor weekly
    - Use volunteer monitoring
    - Use less expensive chromogenic substrate tests
    - Engage local stakeholders to appeal for funding

Public Notification

Types and Triggers

- Advisory
  - Beach manager has information that Increased health risk may exist (health-based standards exceeded)
  - Allows beach users to make personal risk decision based on notification information
  - General, Preemptive and Permanent
  - Trigger: geo.mean/single sample exceedances
- Closure
  - No swimming allowed
  - Trigger: Sewage release to beach

S. California's Signs

Public Notification

Minimum Notification Protocols

- Notify within 48 hrs from sample collection
- Signs at access points & *visible from entire length of beach with poor water quality*

Highly Recommended

- Post on web page within 48 hours
- Notify life guards within 48 hours

Public Notification

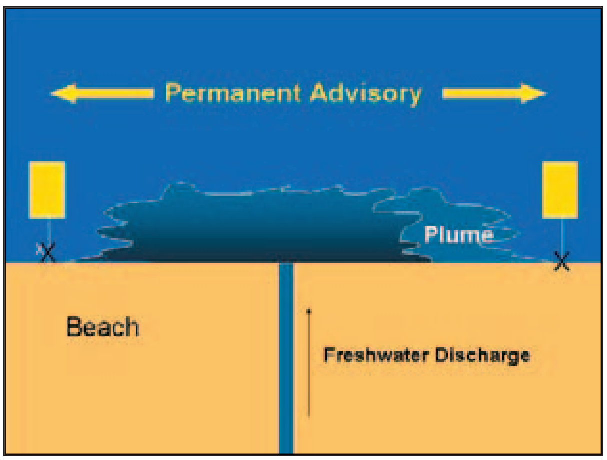
Confirmation Sampling

- Only at low-risk beaches
- Confirmation can occur by:
  - Confirmation in time (two consecutive samples exceed or geometric mean exceedance)
  - Exceedances of multiple indicator standard
  - Confirmation in space (two adjacent monitoring locations)
  - Confirmation by other data (e.g., odors, sanitary debris, etc.)

Public Notification

Permanent Advisory

- High risk beaches
- History of frequent, unpredictable exceedances of standards
- Protocol
  - Issue permanent warning for length of beach with poor water quality
  - Change routine monitoring goal and protocols
  - Conduct characterization survey if necessary
- Examples: storm drain impacted beaches, enclosed beaches



Public Education

- Separate component of program
- Three elements:
  - General beach pollution ed.
  - Beach
  - Outreach
- Outreach to all stakeholders including elected officials, sister agencies, lifeguards, etc.

Recommendations to Improve Public Health Protection

- Require comprehensive minimum protocols for BEACH Act grant funding
- Conduct priority Epi. study research:
  - Chronic exposures
  - Urban runoff and nonpoint source pollution
  - Alternative analytical methods/indicators
  - T/F ratio
  - FIB in tropics/subtropics

Recommendations to Improve M&PN Programs Nationwide

- Develop Rapid Indicators
- Develop source-tracking methods and guidance
- Identify pathogens of concern and develop easy analytical methods
- Assess sand and sediment as sources

www.healthebay.org

Questions and Answers

No questions.

Comparison and Verification of Bacterial Water Quality Indicator Measurement Methods and Using Ambient Coastal Water Samples

John Griffith
Southern California Coastal Water Research Project

Biosketch

Mr. Griffith is a microbiologist at the Southern California Coastal Research Project (SCCWRP). Mr. Griffith received dual B.S. degrees in Biology and Environmental Studies in 1995, and is currently a Ph.D., all at the University of Southern California. He has worked on numerous projects geared toward the development of methods and application of methods to detect and identify sources of fecal contamination and human pathogens in marine waters. Mr. Griffith joined SCCWRP in September 2001. His present research efforts focus on bacterial source tracking, and the development of rapid indicators for the detection of human fecal contamination and pathogens in urban runoff and marine receiving waters.

Abstract

More than 30 laboratories routinely monitor water along southern California's beaches for bacterial indicators of fecal contamination. Data from these efforts are frequently combined and compared even though three different methods (membrane filtration (MF), multiple tube fermentation (MTF) and chromogenic substrate (CS) methods) are used. To assess data comparability and quantify variability within method and across laboratories, 26 laboratories participated in an intercalibration exercise. Each laboratory processed three replicates from eight ambient water samples employing the method or methods they routinely use for water quality monitoring. Verification analyses were also conducted on a subset of wells from the CS analysis to confirm or exclude the presence of the target organism. Enterococci results were generally comparable across methods. There was a 9% false positive rate and a 4% false negative rate in the CS verifications for enterococci, though these errors were small in context of within and among laboratory variability. Fecal coliforms were also comparable across all methods, though CS underestimated the other methods by about 10% because it measures only *E. coli*, rather than the larger fecal coliform group measured by MF and MTF. CS overestimated total coliforms relative to the other methods by several fold and was found to have a 40% false positive rate in verification. Across laboratory variability was small relative to within and among method variability, but only after data entry errors were corrected. Nearly 20% of the labs had data entry errors, which were much larger than any method related errors.

COMPARISON AND VERIFICATION OF BACTERIAL WATER QUALITY INDICATOR MEASUREMENT METHODS USING AMBIENT COASTAL WATER SAMPLES

John F. Griffith

Southern California Coastal Water Research Project (SCCWRP)

Background

- > 30 laboratories routinely monitor microbiological water quality along southern California beaches
- Several different methods are used
  - Membrane filtration (MF)
  - Multiple tube fermentation (MTF)
  - Chromogenic substrate (CS)
- Despite differences between methods, results are often combined or compared.
  - AB411 health warning decisions
  - CWA 311(d) listing

Background (II)

- Previous method comparison studies have used laboratory created water samples.
- Natural samples are more complex.
  - Contain interferences
    - Humic acids
    - Suspended solids
    - Native bacteria that can cause false positive results in CS methods

Purpose

- Assess comparability of results among three different bacterial measurement methods (MF, MTF, CS) using ambient water samples.
- Examine variability among laboratories using the same method.
- Evaluate reliability of CS methods by confirming presence or absence of the target organism.
- Identify common sources of error in determining bacterial concentrations for water quality monitoring purposes.

Methods (I)

- 26 laboratories participated in the study.
- Ambient water samples were aseptically collected from 8 sites in southern California:
  - Open marine beaches
  - Estuaries
  - Creeks (dry weather urban runoff)
- Samples transported on ice to a central location
- 26 sets of 100 ml samples dispensed with constant stirring to ensure homogeneity.

Methods

- Samples analyzed using method or methods routinely performed by each laboratory.
  - MF, MTF,CS (IDEXX media and Quantitray 2000)
  - Processing began simultaneously.
  - Multiple dilutions to ensure quantifiable range.
  - Samples analyzed in triplicate.

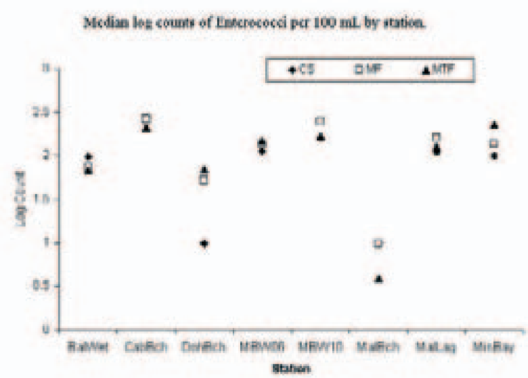
Methods (III)

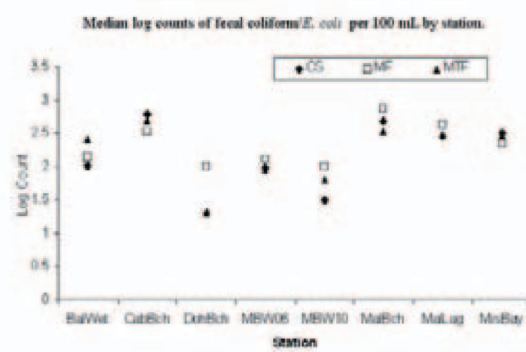
- 5 laboratories performed confirmation testing
  - Secondary biochemical test or Vitek® system
    - 153 total coliform, 35 *E. coli* wells, and 71 enterococci wells
    - 55 non-fluorescing and 21 weakly fluorescing Enterolert® wells tested for false negative results

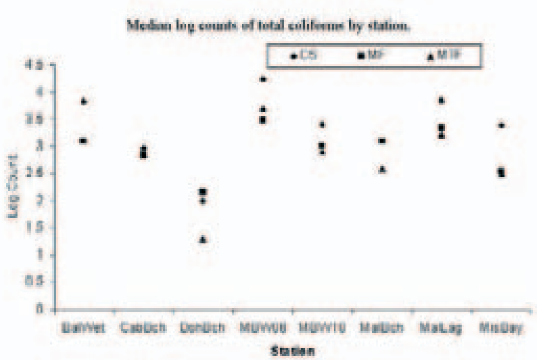
Results

Median concentrations of fecal indicator bacteria per 100 mL reported in each sample across all methods.

Location	Site Description	Enterococci	Fecal Coliforms (*E. coli*)	Total Coliforms
Ballona Wetlands	Estuary	80	130	2400
Cabrillo Beach	Embayment	285	500	820
Doheny Beach	Open Beach	22	20	98
MBW 6	Urban Creek	130	100	12033
MBW 10	Urban Creek	199	41	2000
Malibu Beach	Open Beach	10	488	1194
Malibu Lagoon	Estuary	122	300	5191
Mission Bay	Embayment	120	285	800







Method Comparability

Estimated median ratios of log counts between methods, for each indicator. Asterisk indicates statistically different than 1.

	Enterococci		Fecal Coliform/*E. coli*		Total Coliform
Comparison	All Sites	Without Doheny	All Sites	Without Doheny or MBW10	All Sites
CS/MF	0.71*	0.86	0.69*	0.91	2.54*
CS/MTF	0.80	1.03	1.03	0.95	3.80*
MF/MTF	1.13	1.20	1.46	1.04	1.49

Verification Analyses

- 93 of 153 positive wells (61%) from IDEXX Quantitrays™ were confirmed to contain bacteria from the total coliform group.
- *E. coli* was isolated from all positive wells tested.
- 67 of 71 (94%) fluorescing and 5 of 55 (9%) non-fluorescing Enterolert® wells were confirmed to contain enterococci.
- 3 of 21 tested Enterolert® wells exhibiting weak fluorescence contained enterococci.

Within-lab Variability

- Enterococcus
  - Only 2 labs produced more than one result that differed from the group median by more than ½ log unit.
- Fecal coliforms/*E. coli*
  - 2 labs performing MF and one performing MTF produced values more than ½ log unit above the group median.
- Total coliforms
  - No lab differed by more than ½ log unit from the group median when compared within method.

Method Variability

Confidence intervals for each method applied to concentrations at California's single sample standard value for each indicator.

Method	Enterococci (CA Std.=104)				Fecal Coliform/*E. coli* (CA Std.=400)				Total Coliform (CA Std.=10,000)			
	Above		Below		Above		Below		Above		Below	
	95%	99%	95%	99%	95%	99%	95%	99%	95%	99%	95%	99%
CS	166	217	65	50	624	909	256	197	14955	18880	5297	6681
MF	146	178	73	61	767	1120	208	143	14696	18365	5445	6800
MTF	209	314	52	34	856	1331	186	120	21409	33266	3000	4670

Conclusions

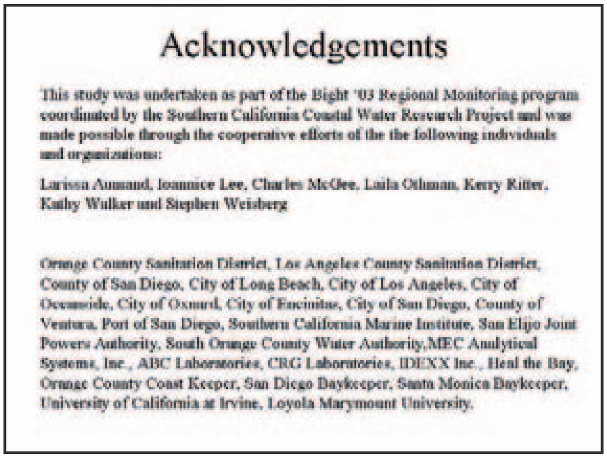
- All 3 methods produced similar results for enterococci.
  - Some false positives and false negatives were confirmed for CS.
  - Both rates were small compared to within-lab and method variability.

Conclusions (II)

- The only large difference between methods was severe overestimation of total coliforms by the CS method.
  - Little practical effect on posting of beach warnings
  - TC standard is almost never exceeded without concurrent exceedence of FC or enterococcus standard.

Conclusions (III)

- Systematic error is of concern, but the largest source of error was attributable to data processing.
  - Pre-screening of results prior to data analysis identified four labs whose results differed by an order of magnitude from those of the other labs.
  - Review of original laboratory data sheets corrected data submission errors.
  - These labs then produced data similar to the other labs.


Acknowledgements
This study was undertaken as part of the Bight '03 Regional Monitoring program coordinated by the Southern California Coastal Water Research Project and was made possible through the cooperative efforts of the the following individuals and organizations:
Larissa Aumand, Ioannice Lee, Charles McGee, Laila Othman, Kerry Ritter, Kathy Walker and Stephen Weisberg
Orange County Sanitation District, Los Angeles County Sanitation District, County of San Diego, City of Long Beach, City of Los Angeles, City of Oceanside, City of Oxnard, City of Encinitas, City of San Diego, County of Ventura, Port of San Diego, Southern California Marine Institute, San Elijo Joint Powers Authority, South Orange County Water Authority,MEC Analytical Systems, Inc., ABC Laboratories, CRG Laboratories, IDEXX Inc., Heal the Bay, Orange County Coast Keeper, San Diego Baykeeper, Santa Monica Baykeeper, University of California at Irvine, Loyola Marymount University.

Questions and Answers

Q (Toni Glymph, Wisconsin Department of Natural Resources): We looked at ambient testing and saw similar results, but when comparing methods with wastewater discharge, we're getting a different picture. Depending on the type of disinfection, test methods, etc., data can be magnitudes different. Have you looked at the types of wastewater? The test methods do not compare when looking at wastewater effluent.

John Griffith

We did not look at any wastewater effluents. The hypothesis is that organisms are susceptible to the different chlorination methods at different levels, so when you grow bacteria on different media you will get differential results. That could be what we saw at Doheny Beach as well.

Comment: UV disinfection gives consistent results, but the chlorination method is completely different. So, it really depends on what test method you use and how you treat your wastewater.

Composite Sampling as an Alternative Technique for the Determination of Bacterial Indicators in Recreational Waters

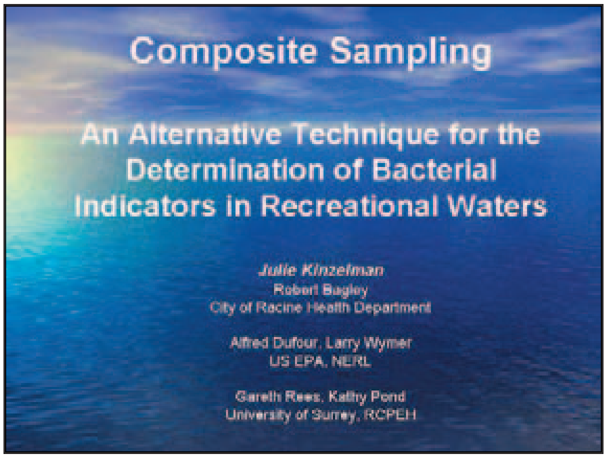
Julie Kinzelman
City of Racine

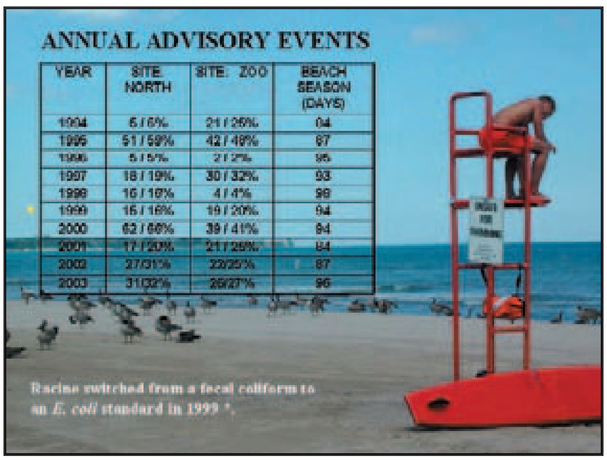
Biosketch

Julie Kinzelman is a microbiologist for the City of Racine Health Department where she has 14 years experience in recreational water quality monitoring and research. Dr. Kinzelman received a BS in Medical Technology from the University of Wisconsin - Parkside, a MS in Clinical Laboratory Sciences from the University of Wisconsin -Milwaukee, and is a Ph.D. Candidate (2005) in Public & Environmental Health at the University of Surrey (Guildford, UK). Dr. Kinzelman is the principal investigator or co-investigator on research initiatives funded by the National Institute of Health, S. C. Johnson Fund, Wisconsin DNR, and Wisconsin Department of Health & Human Services. Her current research activities focus on using public health based monitoring programs to assess the interaction of coastal processes contributing to recreational water quality advisories.

Abstract

The BEACH Act requires states to develop recreational water quality monitoring and notification programs using approved standards. Testing frequency is based on usage and beaches with extensive shorelines, which may require multiple-site sampling, could see significantly increased costs for monitoring recreational waters. This study explored composite sampling at two Racine, Wisconsin beaches over four months (n=68 days) in order to determine whether composite sampling could provide a valid, unbiased, and cost-effective measure of surface water quality. Multiple-point sampling occurred throughout the swimming season with samples being collected daily from three (Zoo Beach) or four (North Beach) fixed sampling points. From each individual sample, well-mixed aliquots were combined to form a single composite sample. Individual and composite samples were analyzed identically for *Escherichia coli* using Colilert-18/Quanti-Tray/2000®. Results indicated a reasonable expectation of a simple 1:1 ratio between the composite samples and the arithmetic mean of the 3 or 4 individual samples. Additionally, log variance of the composite sample results did not differ significantly from that of the single sample averages ($p > 0.2$). Empirical values for log standard deviations varied by no more than 7% between the composite sample and individually assayed samples. In this study, compositing appeared to introduce neither bias nor additional variability into the monitoring results and, therefore, stands as a reasonable alternative to data sets derived from single-sample methods. Regulatory programs requiring large numbers of samples to be analyzed could benefit from the adoption of this type of sampling scheme as a means of reducing the costs associated with the implementation.





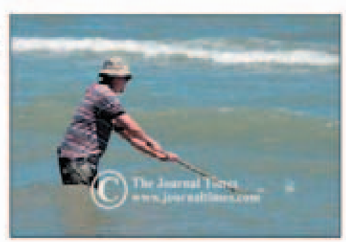
YEAR	SITE: NORTH	SITE: ZOO	BEACH SEASON (DAYS)
1994	6 / 6%	21 / 26%	94
1995	51 / 59%	42 / 48%	87
1996	5 / 5%	2 / 2%	95
1997	18 / 19%	30 / 32%	93
1998	16 / 16%	4 / 4%	98
1999	15 / 16%	19 / 20%	94
2000	62 / 66%	39 / 41%	94
2001	17 / 20%	21 / 25%	84
2002	27/31%	22/25%	87
2003	31/32%	26/27%	96

ADVANTAGES TO INCREASED MONITORING

- Increased frequency of monitoring is more protective of public health
- Increasing the number of sampling events will increase the probability of detecting changes in the bacteriological quality of surface water due to inputs of fecal contamination
- Increasing the number of monitoring stations provides a better characterization of water quality across the entire shoreline

DISADVANTAGES TO INCREASED MONITORING

- **Increased personnel time necessary for sample collection**
- **Increased costs associated with laboratory analysis of samples**



Composite study - 2003

Could we maximize sampling & laboratory analysis while staying within our budget?

Historical Data Assessed Prior to Composite Study

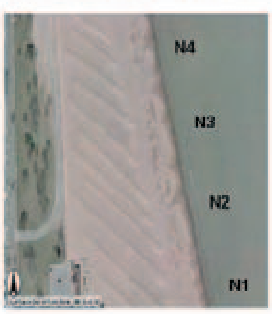
GPS SAMPLING LOCATIONS

SITE	LATITUDE	LONGITUDE	ERROR
N1	N42° 44' 23.5"	W087° 46' 43.8"	17
N2	N42° 44' 27.3"	W087° 46' 45.7"	16
N3	N42° 44' 32.7"	W087° 46' 47.9"	15
N4	N42° 44' 37.2"	W087° 46' 49.6"	15
Z1	N42° 44' 48.8"	W087° 46' 51.6"	13
Z2	N42° 44' 51.2"	W087° 46' 51.9"	12
Z3	N42° 44' 52.6"	W087° 46' 52.0"	13
Mouth of Root River	N42° 44' 00.3"	W087° 46' 18.4"	14
English Street Outfall (Proper)	N42° 44' 41.2"	W087° 46' 54.1"	16
Exit UE Beds	N42° 44' 46.1"	W087° 46' 55.2"	14
Racine Lighthouse (Wind Point)	N42° 46' 51.9"	W087° 45' 26.4"	12

RESULTS OF HISTORIC MONITORING DATA

- Historic single-point data for all beach sampling sites(N1 - N4 and Z1 - Z3) analyzed
- Newman-Keuls multiple comparisons & Tukey multiple comparisons demonstrated no significant difference in the mean *E. coli* concentrations across beach transects
- Population homogenous in nature
- Feasible to conduct composite study at this site.

NORTH BEACH – SAMPLING SITES

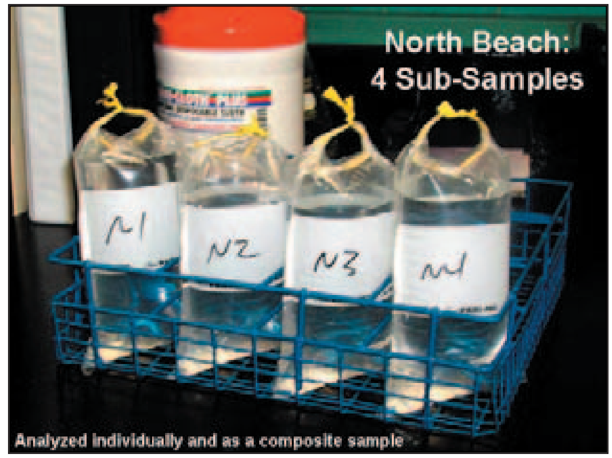


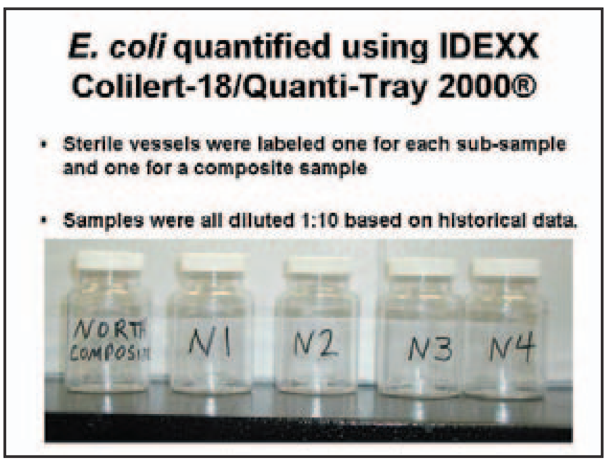
- 4 fixed sampling sites
- Equidistant over length of beach
- Samples collected Monday –Friday
- Collected at depth of 1 meter (0.3 m below the surface)
- Sampling season is late May to early September

ZOO BEACH – SAMPLING SITES

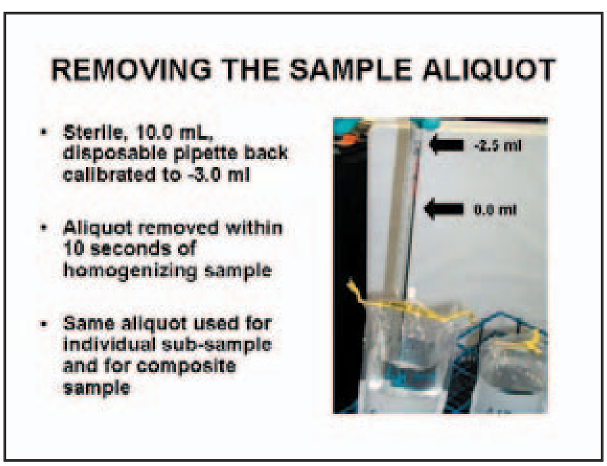
- 3 fixed sampling sites
- Equidistant over length of beach
- Samples collected Monday –Friday
- Collected at depth of 1 meter (0.3 m below the surface)
- Sampling season is late May to early September

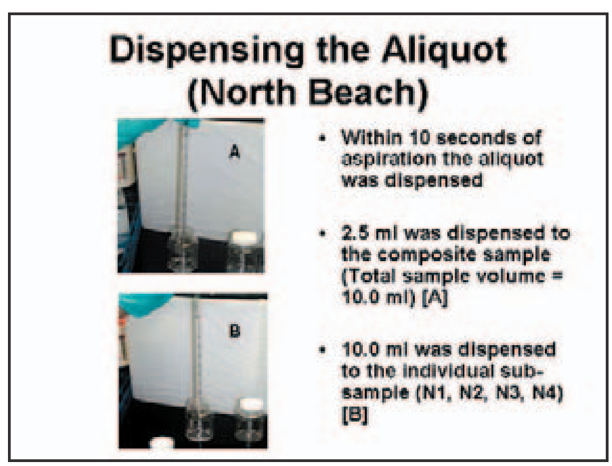

COLLECTION OF SURFACE WATER SAMPLES

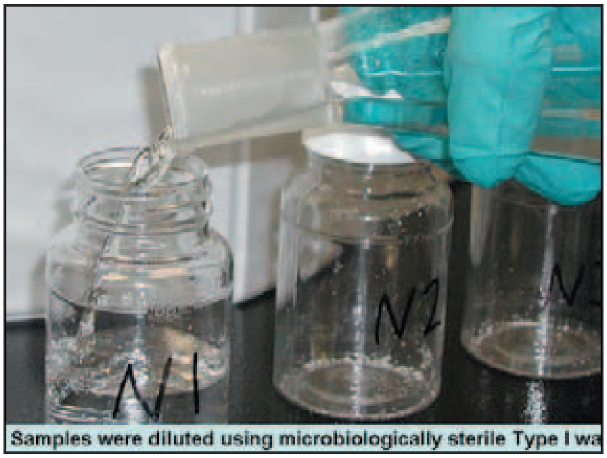

North Beach:
4 Sub-Samples
N1
N2
N3
N4
Analyzed individually and as a composite sample

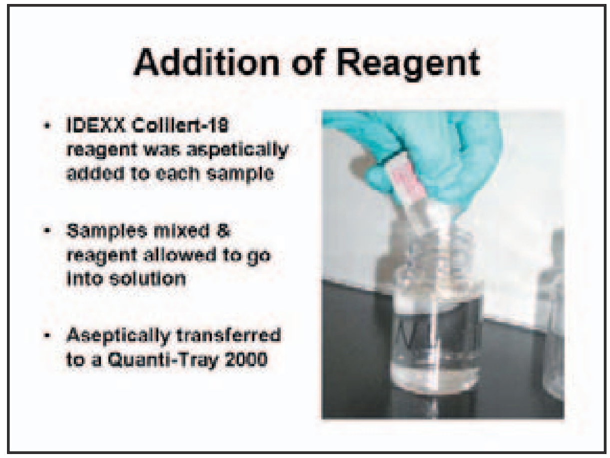

E. coli quantified using IDEXX Colilert-18/Quanti-Tray 2000®
• Sterile vessels were labeled one for each sub-sample and one for a composite sample
• Samples were all diluted 1:10 based on historical data.
N1
N2
N3
N4


Each of the samples was vigorously shaken by hand to ensure homogeneity

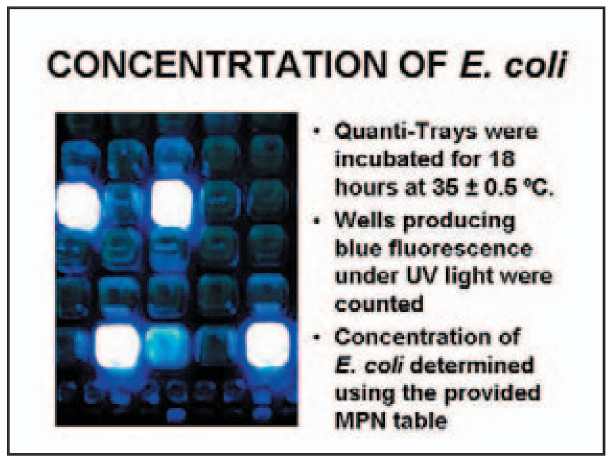

REMOVING THE SAMPLE ALIQUOT
• Sterile, 10.0 mL, disposable pipette back calibrated to -3.0 ml
• Aliquot removed within 10 seconds of homogenizing sample
• Same aliquot used for individual sub-sample and for composite sample
-2.5 ml
0.0 ml

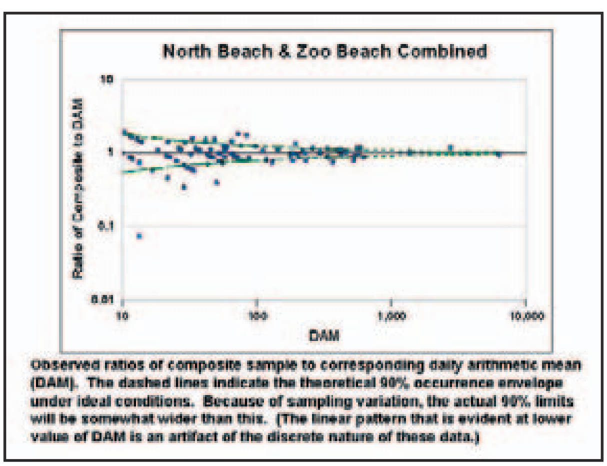

Dispensing the Aliquot (North Beach)
A
B
• Within 10 seconds of aspiration the aliquot was dispensed
• 2.5 ml was dispensed to the composite sample (Total sample volume = 10.0 ml) [A]
• 10.0 ml was dispensed to the individual sub-sample (N1, N2, N3, N4) [B]

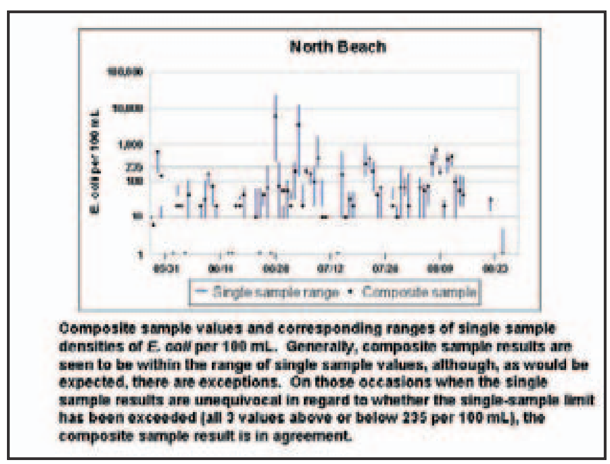

N1
N2
Samples were diluted using microbiologically sterile Type I wa

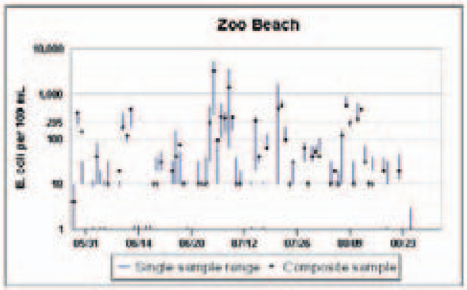

Addition of Reagent
• IDEXX Colilert-18 reagent was aspetically added to each sample
• Samples mixed & reagent allowed to go into solution
• Aseptically transferred to a Quanti-Tray 2000


IDEXX
Quanti-Tray/
2000®
&
Quanti-Tray
Sealer

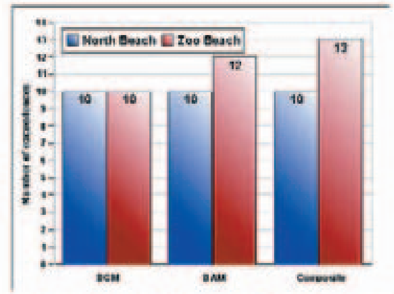

CONCENTRTATION OF E. coli
• Quanti-Trays were incubated for 18 hours at 35 ± 0.5 °C.
• Wells producing blue fluorescence under UV light were counted
• Concentration of E. coli determined using the provided MPN table


North Beach & Zoo Beach Combined
Ratio of Composite to DAM
10
1
0.1
0.01
10
100
1,000
10,000
DAM
Observed ratios of composite sample to corresponding daily arithmetic mean (DAM). The dashed lines indicate the theoretical 90% occurrence envelope under ideal conditions. Because of sampling variation, the actual 90% limits will be somewhat wider than this. (The linear pattern that is evident at lower value of DAM is an artifact of the discrete nature of these data.)


North Beach
E. coli per 100 mL
100,000
10,000
1,000
235
100
10
1
Single sample range
Composite sample
Composite sample values and corresponding ranges of single sample densities of E. coli per 100 mL. Generally, composite sample results are seen to be within the range of single sample values, although, as would be expected, there are exceptions. On those occasions when the single sample results are unequivocal in regard to whether the single-sample limit has been exceeded (all 3 values above or below 235 per 100 mL), the composite sample result is in agreement.



Composite sample values and corresponding ranges of single sample densities of *E. coli* per 100 mL. Generally, composite sample results are seen to be within the range of single sample values, although, as would be expected, there are exceptions. On those occasions when the single sample results are unequivocal in regard to whether the single-sample limit has been exceeded (all 3 values above or below 235 per 100 mL), the composite sample result is in agreement.



Number of single-sample limit exceedences (*E. coli* per 100 mL > 235) for daily geometric mean (DGM), daily arithmetic mean (DAM), and composite samples. For North Beach, this is based on a total of N=68 sampling days, and for Zoo Beach, a total of N=67 sampling days. The relative number of exceedences by each of the three sampling/computational methods will depend on how far above or below the limit the true values are, but in general one expects a higher frequency of exceedence with DAM or composite samples.

RESULTS

- The log variance of composite sample did not differ significantly from that of the single sample arithmetic averages ($p > 0.2$)
- Results from this study indicate a reasonable expectation of a simple 1:1 ratio between the composite samples and the arithmetic mean of the 3 or 4 individual samples
- Empirical values for log standard deviations varied by no more than 7% between the composite sample and individually assayed samples
- Compositing appeared to introduce neither bias nor additional variability into the monitoring.

Days Exhibiting a Difference in Water Quality When Determining *Escherichia coli* Concentration (MPN/100 mL) by Composite Sampling Versus Single Point Samples - North Beach, Racine, WI (2003)

Date	N1	N2	N3	N4	Composite
6-26-03	63	**256**	< 1	< 1	**63**
6-29-03	10	31	**323**	41	**74**
7-3-03	30	**256**	**269**	**327**	**189**
7-6-03	148	187	216	**246**	**187**
7-8-03	20	**249**	175	218	**98**
7-15-03	10	143	97	**650**	**150**
7-23-03	109	**345**	51	228	**185**
7-30-03	< 1	41	41	**243**	**63**
8-9-03	187	142	187	**243**	**171**

Days Exhibiting a Difference in Water Quality When Determining *Escherichia coli* Concentration (MPN/100 mL) by Composite sampling Versus Single Point Samples - Zoo Beach, Racine, WI (2003)

Date	Z1	Z2	Z3	Composite
6-10-03	158	**295**	**379**	**185**
7-3-03	31	**547**	110	**231**
8-9-03	**250**	187	201	**231**

DISCUSSION

- Small number of cases in this study (12 out of a total 135 observations) when there were discrepancies between composite and single point samples
- Could the composite sampling process mask a result which could pose a potential health risk to bathers?
- Basing pass/fail criteria on single samples taken days apart – the current process - is imprecise due to the extreme variability between samples.
- Likelihood of such a one-off result being truly representative is extremely small.
- Compositing samples is a step towards obtaining the best possible characterisation of mean indicator density

DISCUSSION (con.)

- Increase ability to detect true elevations above background levels
- Encourages more sampling
- More reliable estimate of mean indicator density
- Increases chance of detecting results that fall outside the expected range
- Significant financial benefit to agencies responsible for water monitoring programs.

ACKNOWLEDGEMENTS

- City of Racine, Health Department Laboratory
- Gil Dichter & Scott King, IDEXX Laboratories
- S. C. Johnson, A Family Company
- Kevin Longmaid, Farnborough College Of Technology

Questions and Answers

Q: What method is used to monitor the Great Lakes?

Julie Kinzelman

IDEXX Colilert-18 for *E. coli*.

Q: You don't use Enterolort?

Julie Kinzelman

No, because we are looking at fresh water so we test for *E. coli*. Enterococci is also accepted by EPA, and we looked at enterococci in the past as an alternative to *E. coli*. But, we thought we would have more advisories in the absence of a defined public health risk. So, at this point-in-time we continue to use *E. coli*.

Q: Were samples collected away from the tide? You mentioned working in a sterile environment, and I am wondering if the sampler could be exposing himself to the sample bag?

Julie Kinzelman

There is no true tide in the Great Lakes. Samples were collected at arm's length (about 1 foot/0.3 m) below the surface of the water and pulled back up away from the body of the sampler.

Q: Have you ever had a false positive result?

Julie Kinzelman

Not that I'm aware of.

How Often and Where to Monitor: Outcome of the EMPACT Study

Larry Wymer
U.S. Environmental Protection Agency

Biosketch

Larry Wymer is a statistician for the US EPA Office of Research and Development. Mr. Wymer received his MBA in Quantitative Analysis from the University of Cincinnati. He has worked for the National Exposure Research Laboratory in Cincinnati, Ohio for the past 6 years. His main research interests are characterization of recreational water quality and indoor mold. He also serves as an Advisor to ASTM Committee D19 on water.

Abstract

Current EPA recommendations for monitoring the quality of recreational waters calls for the collection of five samples over a 30-day period and the calculation of a running geometric mean to determine if the water quality meets suggested standards. This approach does not provide timely, accurate information for risk managers or the public. A solution to this problem is to develop a statistically valid monitoring protocol which takes into account elements that contribute to the uncertainty associated with sampling bathing beach waters.

EMPACT partner cities, representative of various bathing beach environments, such as marine, freshwater, estuarine, and riverine sites, were recruited to participate in a study monitoring their respective beaches. The major objective of this research was to develop a monitoring protocol for measuring the quality of bathing beach waters describing when, where and how many samples should be taken, and how the data should be analyzed. The collected data were evaluated to develop an economically feasible monitoring protocol to effectively minimize uncertainty about the quality of bathing waters.

Major findings of this study were that distance from shoreline and time of day have significant effects on the results of water quality monitoring. In general, the further away from the shoreline samples were taken, the lower the bacterial densities observed. Indicator levels also tended to be lower in mid-afternoon compared to what they were in the morning. There is an indication that this decline is due to solar radiation, since it tended to be less pronounced, or even non-existent, with increasing cloud cover. Rain, wind direction and velocity, and tides (absolute water level) also significantly influenced bacterial indicator densities at the beaches, while bather density and water temperature did not appear to do so.

Spatial and temporal sources of variation were defined by the study. Replicate variance, sampling depth, distance from shoreline to knee or waist depth, as well as variance between transects from shoreline were all significant contributors to the spatial sources of variation observed at the beaches. Day-to-day variation would be the main source of variability over time. About one-half of the time the change in target indicator density was by a factor of two or more from one day to the next.

These data indicate that only three to six samples taken from water of roughly in the same depth (knee- to chest-deep) may be adequate to characterize water quality at a given point in time. This sample size recommendation is derived not only from variability of target densities observed in this study, but also from consideration of the relative uncertainty inherent in the estimated health effect.

Often and Where to Monitor: Outcomes of the EMPACT Study

Larry J. Wymer

National Beaches Conference, San Diego, CA

October 13-15, 2004

Research and Development at EPA

- 1,950 employees
- $700 million budget
- $100 million extramural research grant program
- 13 lab or research facilities across the U.S.
- Credible, relevant and timely research results and technical support that inform EPA policy decisions

EMPACT Beaches Study "The Team"

- Alfred P. Dufour[1]
- Stephen A. Schaub[2]
- Kristen P. Brenner[1]
- Larry J. Wymer[1]
- John W. Martinson[1]
- Walter R. Stutts[1]

[1] National Exposure Research Laboratory

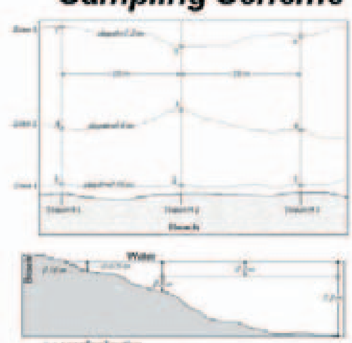
[2] Office of Water

EMPACT Beaches Study

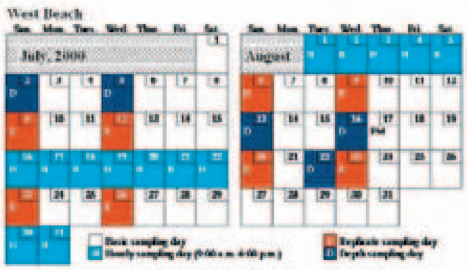
- July-August, 2000
- 5 beaches
- Twice daily sampling
  - Freshwater – *E. coli*
  - Marine/estuarine - enterococci
- 9 "fixed" locations in the water

Study Beaches

Sampling Scheme



Sampling Schedule



Spatial Factors

- Transect (along shoreline)
- "Zone" (water depth)
- Sampling depth

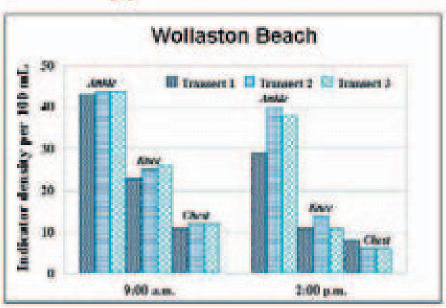
Temporal Factors

- Time of day (a.m. or p.m.)
- Day-to-day
- Day of week

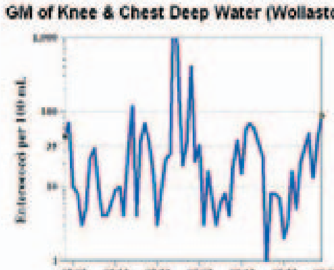
Environmental and Human Effects

- Weather
- Tides and currents
- Bathers

Typical Outcome



Another Typical Outcome



Study Results: Sources of Variation

Location	Source of variation					
	Replicate Samples	Sampling Depth	Depth Zones	Location Within Zone	Hourly 9:00am - 6:00pm)	Among Days
Standard deviations:						
West Beach	0.235	0.212	0.385	0.294	0.383	0.538
Belle Isle	0.193	0.241	1.252	0.375	0.468	0.453
Wollaston Beach	0.309	0.384	0.547	0.383	0.534	0.659
Imperial Beach	0.271	0.384	0.294	0.412	0.508	0.502
Miami Beach Pk	0.198	0.293	0.972	0.450	0.007	0.080

RESEARCH & DEVELOPMENT
Building a scientific foundation for sound environmental decisions

Sample Size Requirements

Location	Log Action Level	Sample size required for a 95% confidence limits of:	
		+/-0.2 logs	+/-0.3 logs
West Beach	2.10	5	3
Belle Isle	2.10	9	4
Wollaston Beach	1.54	8	4
Imperial Beach	1.54	12	5
Miami Beach Park	1.54	14	6

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Building a scientific foundation for sound environmental decisions

Is This Good Enough?

- In terms of the geometric mean:
  - +/- 0.3 logs is a factor of 2
    - If GM=35, 95% C.L. = 17.5 to 70
  - +/- 0.2 logs is a factor of 1.5
    - If GM=35, 95% C.L. = 23 to 53

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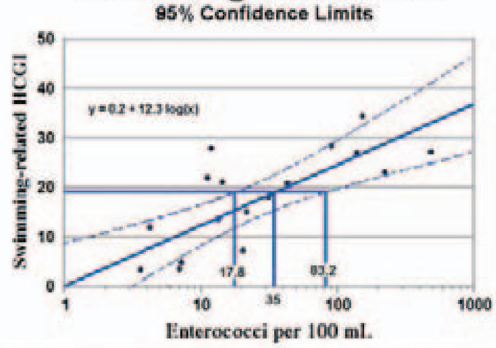
Building a scientific foundation for sound environmental decisions

Swimming-related Risk

95% Confidence Limits



RESEARCH & DEVELOPMENT
Building a scientific foundation for sound environmental decisions

+/- 0.3 Logs Appears to Be Adequate

- 95% C.L. for added risk of HCGI equal to 19 per 1000:
  - 17.8 – 83.2 enterococcci/100 mL or
  - 1.25 – 1.92 logs (0.67 log range)
- +/- 0.3 logs ✞

RESEARCH & DEVELOPMENT
Building a scientific foundation for sound environmental decisions

Lessons From the EMPACT Beaches

- ~3-5 samples in water of swimming depth
- Daily sampling (or as often as relevant)
  - Sample in a.m.
  - Rapid methods or accurate "nowcasting"

RESEARCH & DEVELOPMENT
Building a scientific foundation for sound environmental decisions

Questions and Answers

Q: From a bacteria study in San Juan Creek, samples collected near storm drain outlets had high concentrations of bacteria, including enterococcus. Also, the effects of sunlight may have reduced bacteria (Enterococcus). Can you demonstrate the die-off rate statistically? Is there a hypothesis on why bacteria would be persistent near the surface of water (closer to sunlight) in the ankle water? I assume when you say "ankle water" you mean that samples were taken in water that was ankle-deep. Is there a correlation with temperature? I t would seem that the bacteria counts would be inversely related to the temperature.

Larry Wymer

We did not see any change with temperature, which could be because the temperature did not vary much. However, there was definitely an effect of sunshine. The decline of bacteria was greater on sunny days compared to cloudy days, from morning to afternoon. Although, hourly samples did not show a consistent pattern in levels of bacteria.

Comment (Mark Gold, Heal the Bay): Heal the Bay, the City of Los Angeles, and the Los Angeles County Sanitation District did a very similar study about 15 years ago and got almost identical results, with high densities in morning. The project also showed a difference in bacteria levels among ankle, waist and chest depths. Although, temperature does not tend to vary enough to drive any results.

Q (Dustin Bambic, Larry-Walker Associates): You seem to be aware of the UV degradation that bacteria exhibit during the day. Are there any studies where the pathogens themselves showed a similar response to UV, since we are looking for the pathogens and not the bacteria themselves?

Larry Wymer

Yes. I hear that it's not just UV that causes degradation, but also visible light.

Mark Gold

I have not seen any pathogens studies, but I know that when Rachel Noble was at SCCWRP they did some extensive work on the indicators, but not on the pathogens themselves.

Comment (Dustin Bambic): I have done studies with sunlight and saw that it goes into the visible range [tape inaudible].

Wednesday, October 13

3:20 p.m. – 5:00 p.m.

Session Four:
The Public Notice Decision Process and Public Perception

Source Unknown: Questionable Geometric Mean Exceedances at Two Pristine North Carolina Beaches

J.D. Potts
North Carolina Department of Environment and Natural Resources

Biosketch

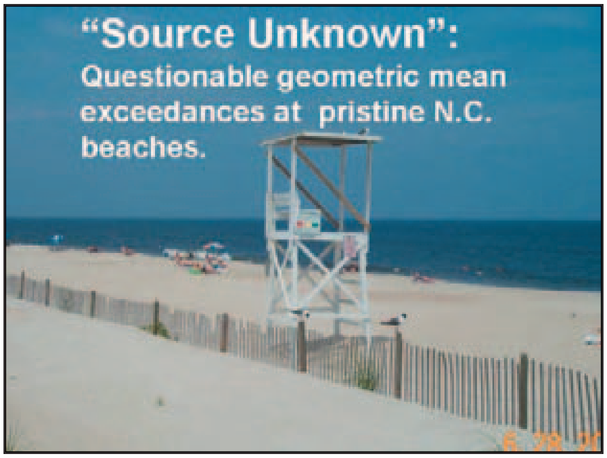
Mr. J.D. Potts is the manager of North Carolina's Recreational Water Quality Program. Mr. Potts received his B.S. in Fisheries and Wildlife Science from North Carolina State University. He has worked for the N.C. Division of Environmental Health in the Shellfish Sanitation and Recreational Water Quality Section for fifteen years. He worked as a shoreline surveyor for eight years before starting the state's recreational water quality program in 1997. He currently directs the program's statewide coastal recreational water quality activities.

Abstract

North Carolina's Recreational Water Quality Program tests 240 sites along the ocean beaches, sounds, and coastal rivers. During the 2004 swimming season, the program posted several swimming advisories at historically pristine beaches, including a public access ocean site in Carteret County and the Cape Hatteras Lighthouse in the Outer Banks in Dare County. These sites experienced high initial counts and the Carteret Co. site then experienced a high count on the re-sampling. The high sample results changed the basis of the swimming advisories from exceeding single-sample levels to exceeding the monthly geometric mean. Geometric mean exceedances require that the weekly sample results drop below the limit before the advisory is removed.

The high samples kept the geometric mean over the standard for over a month in the Carteret County case, with the sign staying up for four weeks while weekly tests showed minimal counts. No source of pollution was identified at the Carteret site. The single high sample for the Cape Hatteras Lighthouse resulted in the advisory remaining for a week, based on daily sampling results that were taken after a possible source was identified and removed. If the possible source, a National Park Service drainage culvert, had not been identified and closed, this advisory is likely to have remained up for several weeks as well, despite subsequent low bacterial counts.

These occurrences raise questions about whether the current geometric mean practices portray an accurate picture of coastal recreational water quality. The adverse public perceptions these advisories cause do not reflect actual water quality public health risks.



Shellfish Sanitation and Recreational Water Quality Section

N.C. Division of Environmental Health
Dept. of Environment and Natural Resources

Overview of N.C. RWQ Program

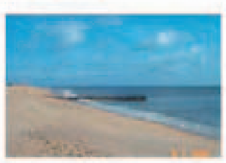
- 240 swimming sites monitored.
- 17 people directly involved in the RWQ program during the swimming season.
- 5 of the 17 people are funded by the BEACH grant.

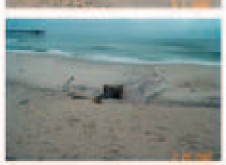
Overview of N.C. RWQ Program

- 3 regional labs.
- 12 boats for sampling interior waters.
- Annual budget approximately $545,000.
- $240,000 N.C. + $305,000 grant.

Storm Drains

- New rules require all actively discharging pipes to be posted.
- 10 ocean storm drains have dry weather discharges.
- 10 additional ocean storm drains have wet weather discharges.

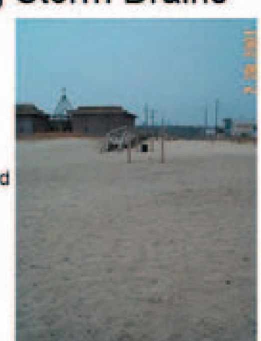




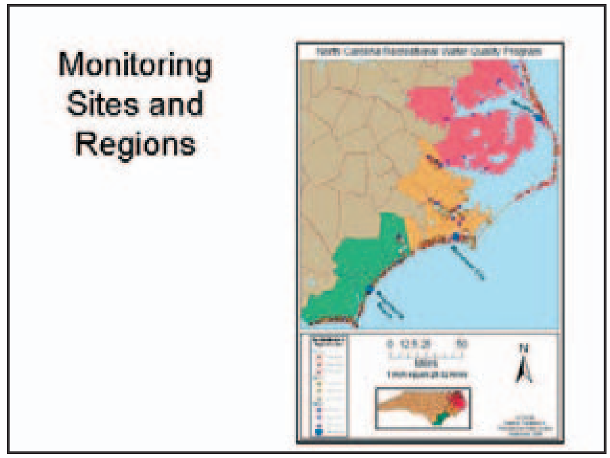
Non-Discharging Storm Drains

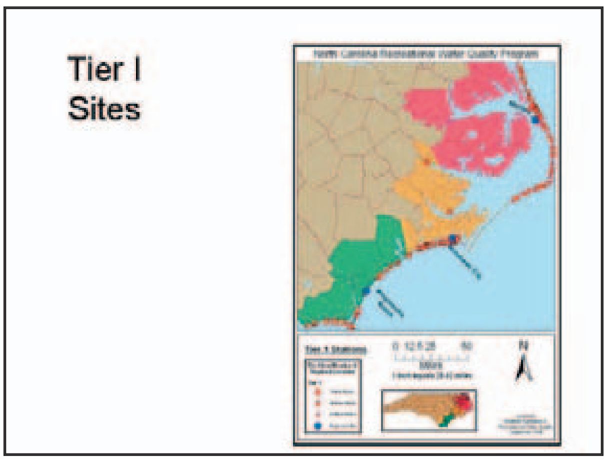
Approximately 15 storm drains are sanded over and do not actively discharge.

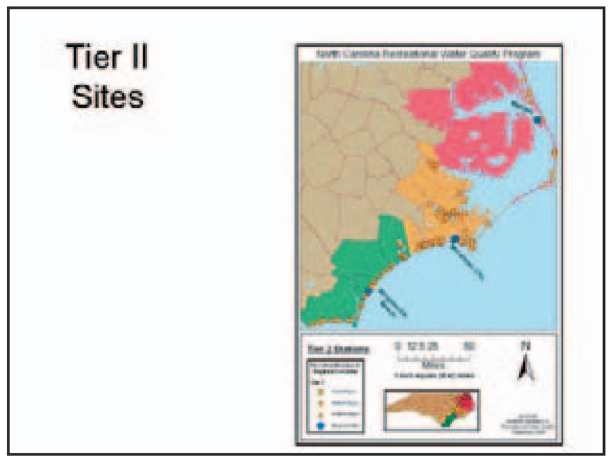
N.C. legislature recently allocated $15 million to NCDOT to find solutions for ocean storm drains.

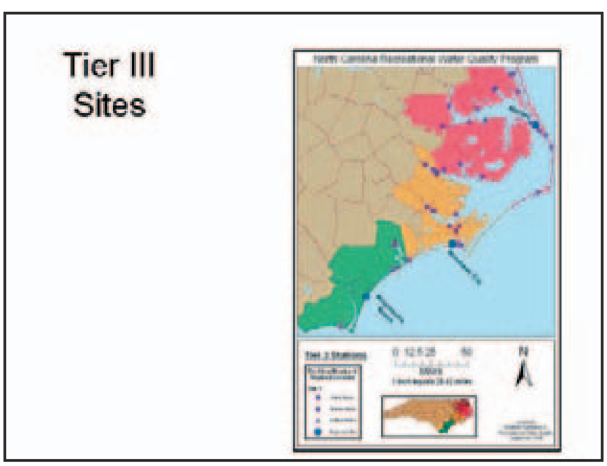


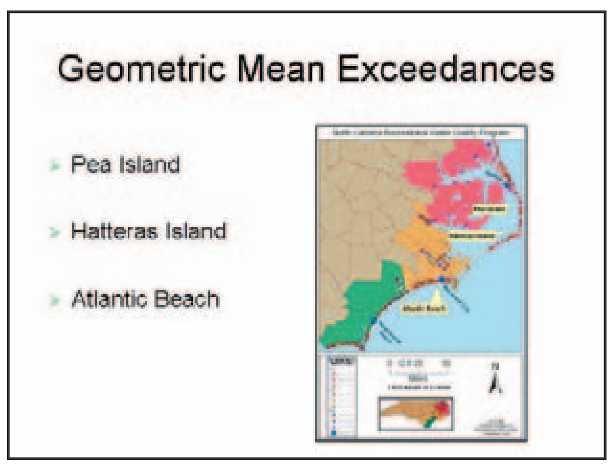

9.13.2000

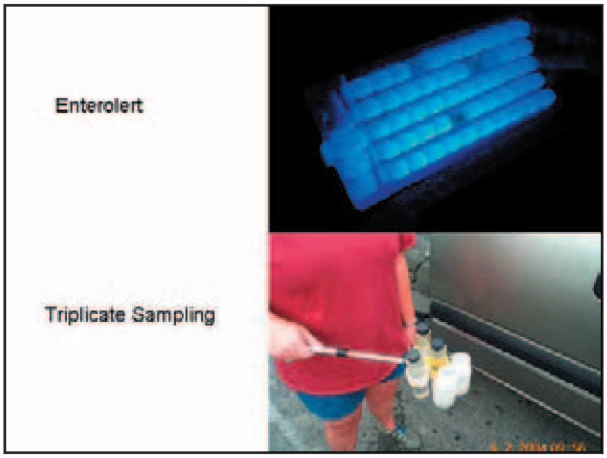

Monitoring Sites and Regions

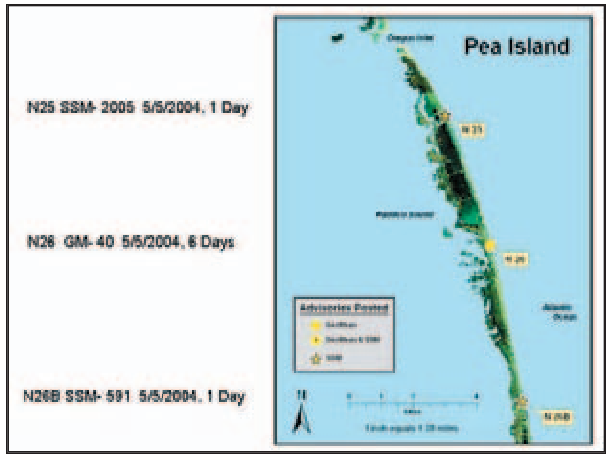

Tier I Sites

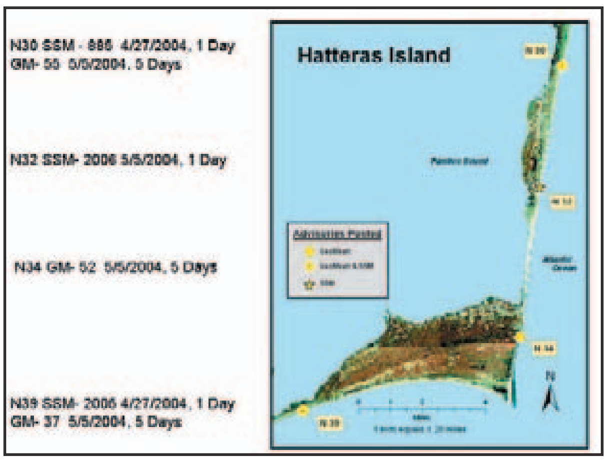

Tier II Sites

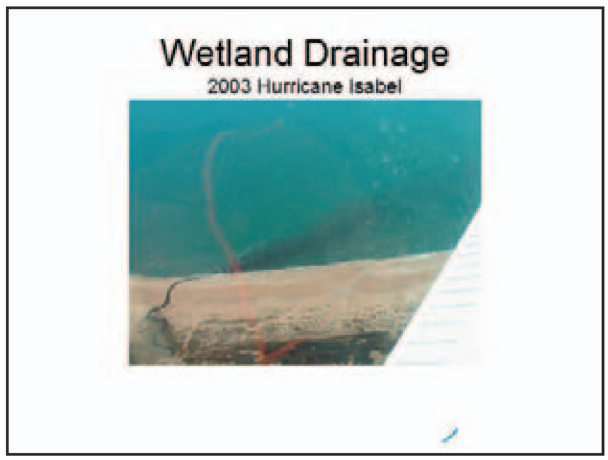

Tier III Sites

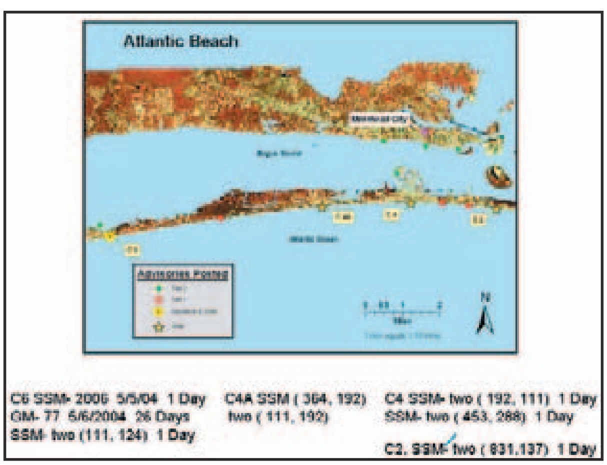

Geometric Mean Exceedances
Pea Island
Hatteras Island
Atlantic Beach


Enterolert
Triplicate Sampling


Pea Island
N25 SSM- 2005 5/5/2004, 1 Day
N26 GM- 40 5/5/2004, 6 Days
N26B SSM- 591 5/5/2004, 1 Day


Hatteras Island
N30 SSM - 886 4/27/2004, 1 Day
GM- 55 5/5/2004, 5 Days
N32 SSM- 2006 5/5/2004, 1 Day
N34 GM- 52 5/5/2004, 5 Days
N39 SSM- 2006 4/27/2004, 1 Day
GM- 37 5/5/2004, 5 Days


Wetland Drainage
2003 Hurricane Isabel


Atlantic Beach
C6 SSM- 2006 5/5/04 1 Day
GM- 77 5/6/2004 26 Days
SSM- two (111, 124) 1 Day
C4A SSM (364, 192)
two (111, 192)
C4 SSM- two (192, 111) 1 Day
SSM- two (453, 288) 1 Day
C2. SSM- two (831,137) 1 Day


6. 2. 2004 10:42


6. 2. 2004 10:43


6. 2. 2004 10:44

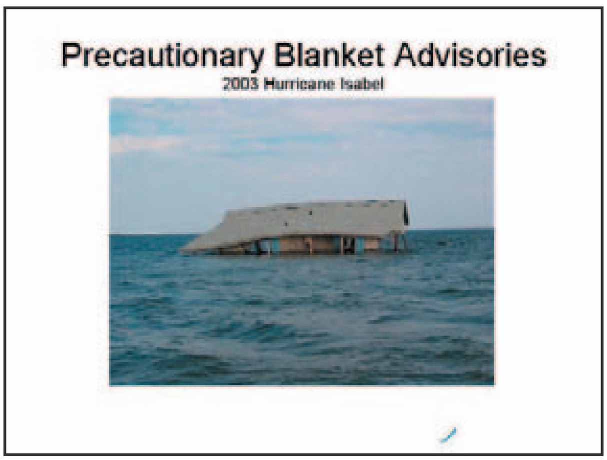

6. 2. 2004 10:44


6. 2. 2004 10:45


6. 2. 2004 10:46


6. 2. 2004 10:46


6. 2. 2004 10:47


Precautionary Blanket Advisories
2003 Hurricane Isabel

Conclusion

- States should be able to use best profession judgment for rescinding geometric mean advisories at sites with no pollution sources when sampling indicates no further problems.
- EPA guidance for blanket precautionary advisories associated with storms would be helpful.

Questions and Answers

No questions.

Misinformation in Beach Warning Systems

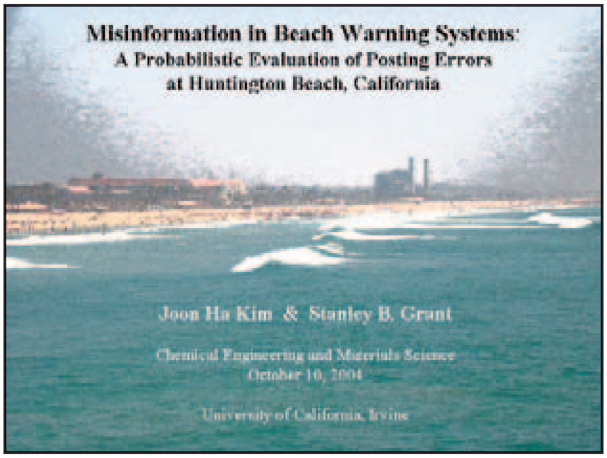
Stanley Grant
University of California at Irvine, Henry Samueli School of Engineering

Biosketch

Dr. Stanley B. Grant is Professor of Environmental Engineering, and Chair of the Department of Chemical Engineering & Materials Science at the University of California, Irvine (UCI). Dr. Grant received a B.S. (with distinction) in Geology from Stanford University (1985) and a M.S. and Ph.D. in Environmental Engineering Science from the California Institute of Technology (1990 and 1992, respectively). Dr. Grant studies the sources, fate, and transport of pathogens and indicator organisms in drinking water, urban runoff, and the coastal ocean. He is a member of the US Environmental Protection Agency's Science Advisory Board (Drinking Water Panel), and is the lead on several multidisciplinary research projects, including one on the influence of tidal wetlands on coastal pollution (joint with researchers from UCI, Scripps Institution of Oceanography, and UCLA, funded by the University of California Marine Council); another on the association of pathogens and particles in storm runoff (joint with researchers from UCI and UCSB, funded by the US Geological Survey and the National Water Research Institute); and a third on the contribution of marinas to fecal indicator bacteria impairment in tidal embayments (in support of the Newport Bay Fecal Coliform TMDL, funded by the California State Water Quality Control Board). Dr. Grant is recipient of the prestigious Career Award from the National Science Foundation (1985-2000), and a number of local awards including Conservator of the Year (2002) from the Bolsa Chica Wetlands Conservancy, and the Distinguished Assistant Professor Award for Teaching from the UCI Academic Senate (1999).

Abstract

Whenever measurements of fecal pollution in coastal bathing waters reach levels that might pose a significant health risk, warning signs are posted on public beaches in California. Analysis of historical shoreline monitoring data from Huntington Beach, southern California, reveals that protocols used to decide whether to post a sign are prone to error. Errors in public notification (referred to here as posting errors) originate from the variable character of pollutant concentrations in the ocean, the relatively infrequent sampling schedule adopted by most monitoring programs (daily to weekly), and the intrinsic error associated with binary advisories in which the public is either warned or not. In this paper, we derive a probabilistic framework for estimating beach posting error rates, which at Huntington Beach range from 0 to 41%, and show that relatively high sample-to-sample correlations (>0.4) are required to significantly reduce binary advisory posting errors. Public mis-notification of coastal water quality can be reduced by utilizing probabilistic approaches for predicting current coastal water quality, and adopting analog, instead of binary, warning systems.



Ocean Bathing Water Quality Standards for FIB in California

- Total Coliform
  - 10,000 MPN/100 mL (single sample)
  - 1,000 MPN/100 mL (30-day geo mean)
- Fecal Coliform
  - 400 MPN/100 mL (single sample)
  - 200 MPN/100 mL (30-day geo mean)
- Enterococci bacteria
  - 104 MPN/100 mL (single sample)
  - 35 MPN/100 mL (30-day geo mean)

Posting/Closure Protocol in California

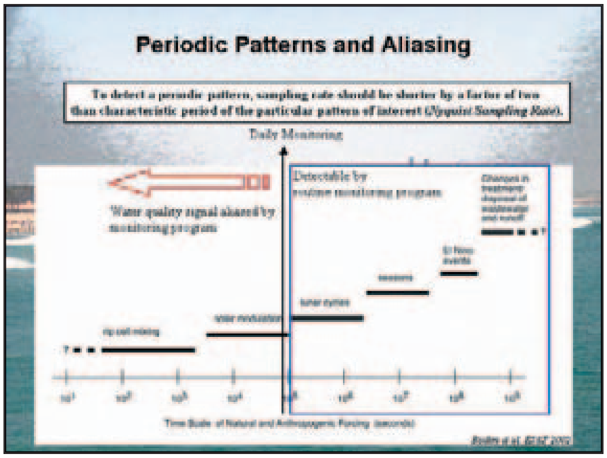
- If FIB concentrations in the surf exceed any of these standards, the local health officer is required to post a sign on the beach warning the public about potential health risks (*beach posting*)
- If the local health officer believes that the surf may be contaminated with sewage, he/she has the option of closing the beach to the public (*beach closure*)

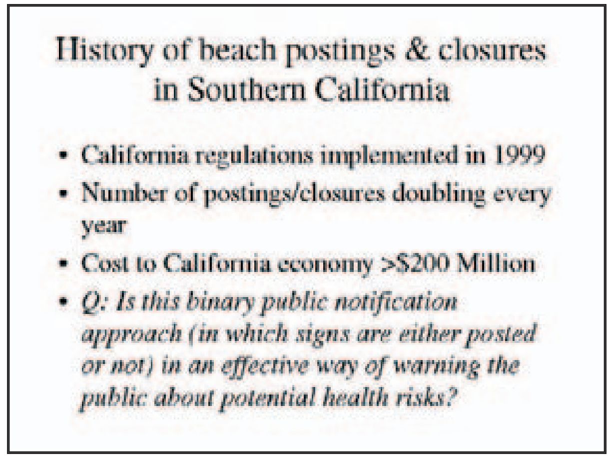
Primary Research Questions

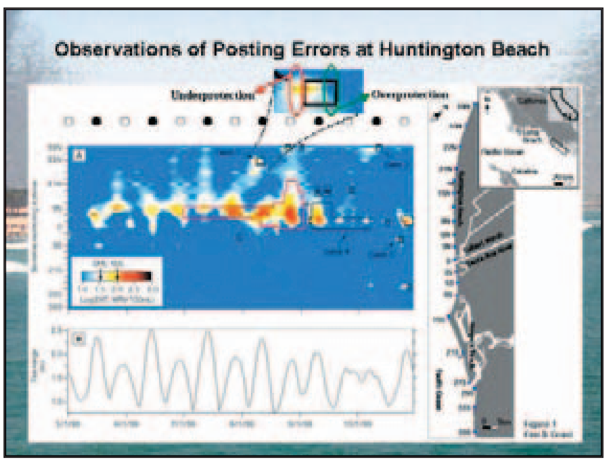
- Can the posting error rates observed at Huntington Beach be rationalized with a simple probability model for binary advisories?
- Can public advisories be improved by adopting probabilistic approaches for forecasting (or now-casting) water quality?

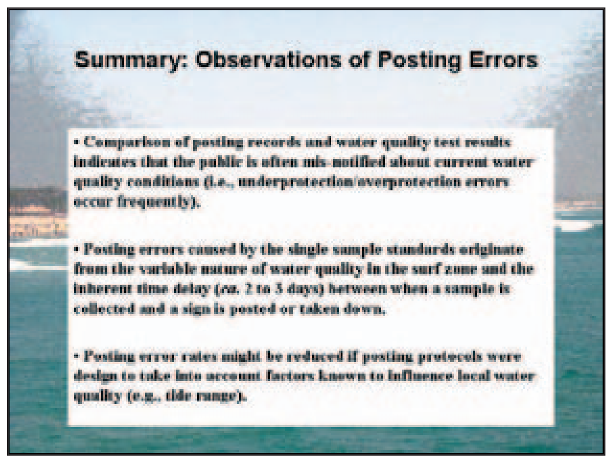
What factors influence water quality test results?

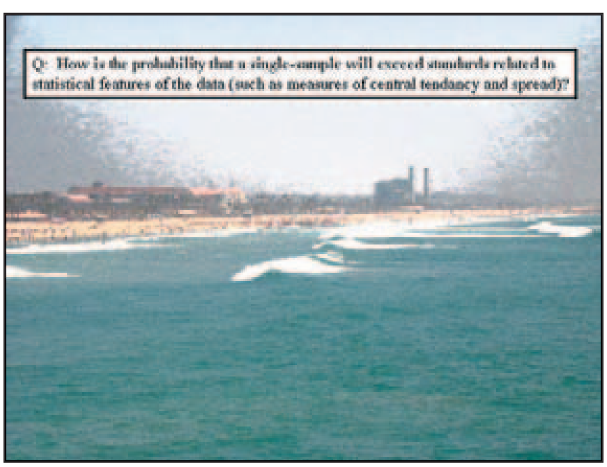
- A cascade of periodic cycling driven by both anthropogenic activities and physical processes (next slide)
- Errors associated with the test results themselves (ca., 20-30%)

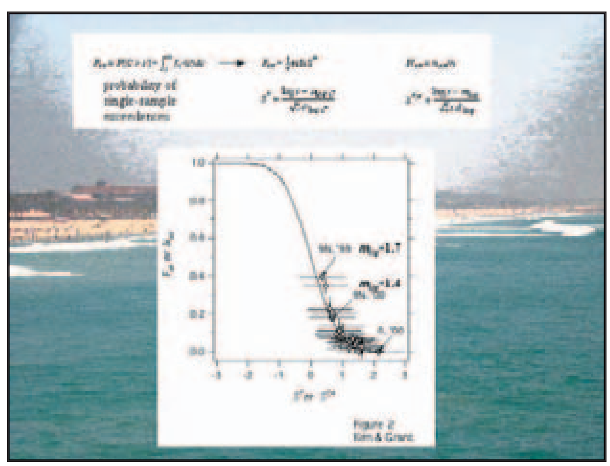

Periodic Patterns and Aliasing
To detect a periodic pattern, sampling rate should be shorter by a factor of two than characteristic period of the particular pattern of interest (Nyquist Sampling Rate).
Daily Monitoring
Detectable by routine monitoring program
Water quality signal aliased by monitoring program
Time Scale of Natural and Anthropogenic Forcing (seconds)

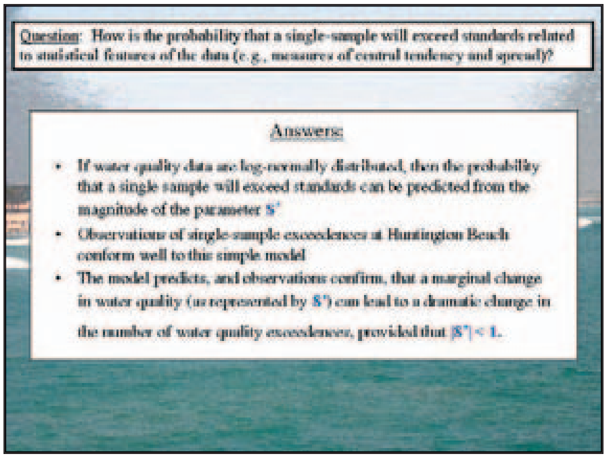

History of beach postings & closures in Southern California
• California regulations implemented in 1999
• Number of postings/closures doubling every year
• Cost to California economy >$200 Million
• Q: Is this binary public notification approach (in which signs are either posted or not) in an effective way of warning the public about potential health risks?


Observations of Posting Errors at Huntington Beach
Underprotection
Overprotection

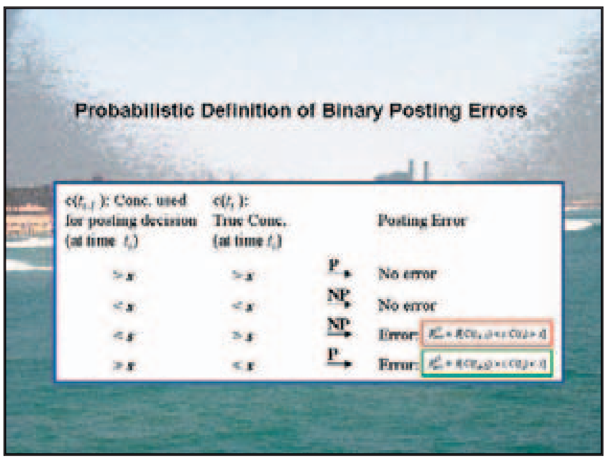

Summary: Observations of Posting Errors
• Comparison of posting records and water quality test results indicates that the public is often mis-notified about current water quality conditions (i.e., underprotection/overprotection errors occur frequently).
• Posting errors caused by the single sample standards originate from the variable nature of water quality in the surf zone and the inherent time delay (ca. 2 to 3 days) between when a sample is collected and a sign is posted or taken down.
• Posting error rates might be reduced if posting protocols were design to take into account factors known to influence local water quality (e.g., tide range).

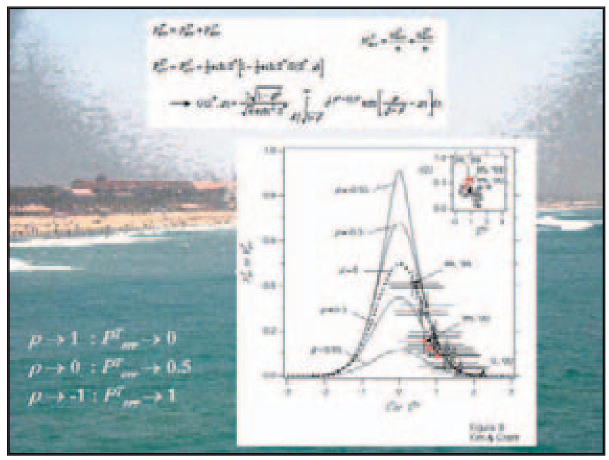

Q: How is the probability that a single-sample will exceed standards related to statistical features of the data (such as measures of central tendancy and spread)?

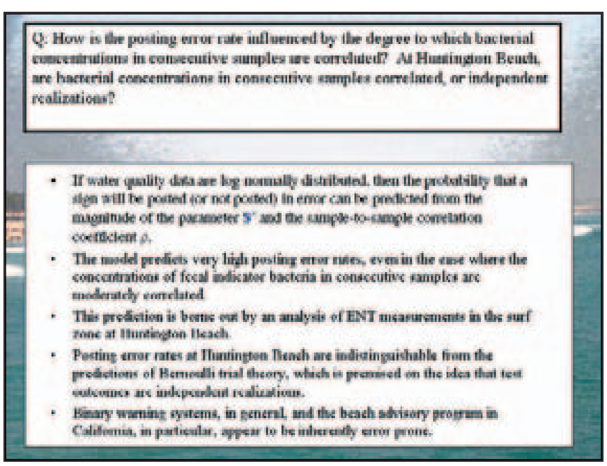

probability of single-sample exceedences
Figure 2
Kim & Grant


Question: How is the probability that a single-sample will exceed standards related to statistical features of the data (e.g., measures of central tendency and spread)?
Answers:
• If water quality data are log-normally distributed, then the probability that a single sample will exceed standards can be predicted from the magnitude of the parameter S*
• Observations of single-sample exceedences at Huntington Beach conform well to this simple model
• The model predicts, and observations confirm, that a marginal change in water quality (as represented by S*) can lead to a dramatic change in the number of water quality exceedences, provided that |S*| < 1.

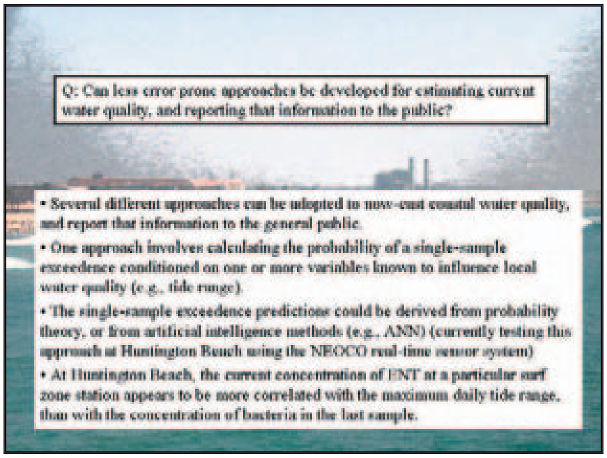

Q: How is the posting error rate influenced by the degree to which bacterial concentrations in consecutive samples are correlated? At Huntington Beach, are bacterial concentrations in consecutive samples correlated, or independent realizations?

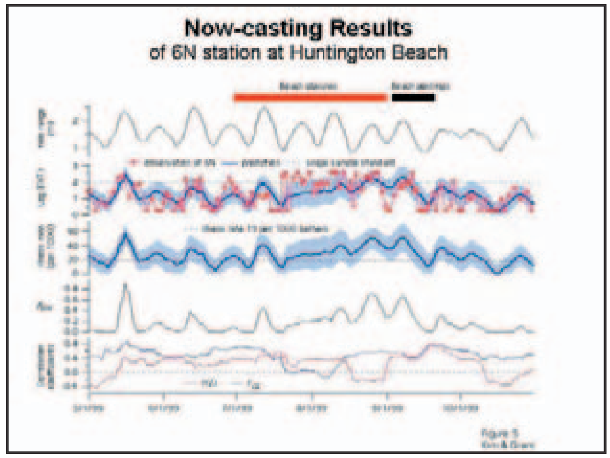

Probabilistic Definition of Binary Posting Errors
c(t_{i-1}): Conc. used for posting decision (at time t_i)
c(t_i): True Conc. (at time t_i)
Posting Error
> x > x P No error
< x < x NP No error
< x > x NP Error
> x < x P Error


ρ → 1 : P → 0
ρ → 0 : P → 0.5
ρ → -1 : P → 1


Q: How is the posting error rate influenced by the degree to which bacterial concentrations in consecutive samples are correlated? At Huntington Beach, are bacterial concentrations in consecutive samples correlated, or independent realizations?
• If water quality data are log normally distributed, then the probability that a sign will be posted (or not posted) in error can be predicted from the magnitude of the parameter S* and the sample-to-sample correlation coefficient ρ.
• The model predicts very high posting error rates, even in the case where the concentrations of fecal indicator bacteria in consecutive samples are moderately correlated.
• This prediction is borne out by an analysis of ENT measurements in the surf zone at Huntington Beach.
• Posting error rates at Huntington Beach are indistinguishable from the predictions of Bernoulli trial theory, which is premised on the idea that test outcomes are independent realizations.
• Binary warning systems, in general, and the beach advisory program in California, in particular, appear to be inherently error prone.


Q: Can less error prone approaches be developed for estimating current water quality, and reporting that information to the public?





Acknowledgments

- Funding from the UCMC
- Beach slide from A. Boehm
- Many colleagues and reviewers for "feedback"

A paper describing this work was published in a recent issue of Environmental Science and Technology, along with two other papers focused on various aspects of the surf zone pollution at Huntington Beach
If you want copies, contact me at sbgrant@uci.edu

Questions?

Questions and Answers

Q (Bob Peeples, Earth 911): When fitting to log normal distribution, how do you allow for the fact that you can't go below the detection limit?

Stanley Grant
Throw out the non-detects. They contain no information.

Q: Do you think that your approach will be useful to help us understand if the samples that we do take will be meaningful to protect public health?

Stanley Grant
Focus on the indicators and pathogens relationship; know that one can be present without the other (and vice versa). We're working on trying to learn what are the physical transport processes that move the bacteria and pathogens, how is the transport process reflected in variability patterns, and how the patterns can be transferred to a probabilistic framework that can be useful for health risk.

We learn from cases where indicator bacteria and pathogens have a common source. We learn that what applies to one case often applies to the other. For example, during a storm event there is an infinite supply of indicator bacteria, but human viruses are diluted by the volume of water. Be careful of decoupling.

The Cost of Beach Water Monitoring Errors in Southern California

Linwood Pendleton
University of California at Los Angeles, School of Public Health

Biosketch

Dr. Linwood Pendleton received a B.S. in Biology (with a chemistry minor) from the College of William and Mary, an M.A. in Biology from Princeton University (for studies in tropical ecology), a Masters of Public Administration from Harvard's Kennedy School of Government, and a Doctor of Forestry and Environmental Studies in Natural and Environmental Resource Economics from the School of Forestry and Environmental Studies at Yale University. Dr. Pendleton works broadly in the area of coastal and ocean economics, with an emphasis on the economic impacts of coastal water quality pollution. Dr. Pendleton is the lead economist for the National Ocean Economics Project's Non-Market Values Information System.

Abstract

The current protocol and method of monitoring recreational water quality in the United States is known to be imperfect. On site sampling, off site laboratory analysis, and a reliance on fecal indicator bacteria instead of human pathogens result in two principle types of errors associated with water quality monitoring (Rabinovici et al 2004): 1) Type I errors in which beaches are closed even though water quality parameters are within a compliance range thought to be safe for swimming and 2) Type II errors in which water quality parameters exceed safe compliance levels yet beaches are not closed. The causes of these errors include a) precautionary beach closures when a source of contaminants are known, but the exact fate of contaminants in near shore waters is not known and b) lag times of two or more days between sampling and notification of water quality impairment. We estimate the economic cost of these errors using a retrospective analysis of beach closures and beach attendance in Los Angeles and Orange Counties. This study finds that a complete elimination of these types of errors in Los Angeles and Orange County could result in an annual economic savings of approximately $8 million annually.

Examining the Potential Economic Benefits of Improving Coastal Water Quality Monitoring in Southern California

Linwood Pendleton
Environmental Science and Engineering and Institute of the Environment, UCLA

Mission:

1) Maximize Recreation

2) Protect Public Health

Protecting Public Health: Beach Monitoring

Is Water Quality Within Safe Limits?

Yes — No

Benefit: Public Health Savings

Cost: Lost Recreation

Beach Monitoring Errors

Within Water Quality Standards

Yes — No

Open | Closed | Open | Closed

Economic Perspective

√

Type I Error: Lost Recreation Values

Type II Error: People Get Sick!

√

Two Important Types of Error:

1) Type I:

Overly Prudent Closures
(Closing all adjacent beaches)

2) Type II:

Time Delay b/w Monitoring and Closure (2 or 3 days)

Consequences

1) Overly Prudent Closures

Unnecessary loss of recreational value

2) Time Delay

Unnecessary exposure → Public health burden

(i.e. sickness has a cost)

What's the Cost of Unnecessary Closures?

Average # Closure Days in LA and OC (1999-2002): 147

What's the Cost of Unnecessary Closures?

Average # Closure Days in LA and OC (1999-2002): 147

How can we reduce geographic extent of beach closures?

1. More monitoring stations
2. Nearshore current monitoring
3. Modified Coastal Ocean Observing System

What If We Reduced the Geographic Extent of Closures by ½?

Reduce loss of beach visits ➔ saved expenditures
➔ saved non-market values

What are non-market values?

1) Economic harm to beach goers
2) Represents value beyond what you pay
3) Increased costs of going to other beaches
4) Recognized in litigation

What's the economic impact of closures[1]?

Economic Cost of 147 beach closures/year:

Annual Lost Expenditures = $8million - $18million

Lost Recreational Value = $4million - $7million

Economic Benefit of Reducing beach closures/year (1/2):

Annual Lost Expenditures = $4million - $9million

Lost Recreational Value = $2million - $3.5million

TOTAL = $6million/year

1. See Pendleton 2004 for a summary of studies.

What's the Cost of Unnecessary Exposure?

Increased Illness ➔ Increased Cost of Illness
1) Cost of medical care
2) Cost of lost time at work
3) WTP to avoid sicknesses

What kinds of illness?
1) HCGI – Gastroenteritis
2) Fever
3) Ear/Eye Ailments
4) Skin Rash

What is the Exposure?

1) Attendance data for two days prior to closures
2) Assume that only 28% of beach goers swim
   1) Pendleton et al. 2001 – 38%
   2) Hanemann, Pendleton, et al. – 28%
3) Assume that
   a) If closure lasts 2+ days, then exposure lasted 2 days including sample day
   b) If closure lasted 1 day, then exposure lasted 1 day (sample day)

What's the Increased Risk of Illness?

Illness	Excess Rate of Illnesses for Swimmers (x/100, sewage contamination – background levels[a])
Gastroenteritis	8.4
Acute Febrile Respiratory	0.1
Ear ailments	4.6
Eye Ailments	2.5

[a]From Fleisher et al. (1998). [b]From Haile et al. (1999)

What's the Cost per Illness?

Rabinovici et al. 2004:
Cost of Food Borne Illness = $280/case

Bloomquist et al. (2001):
Cost of Flu = $380

To be conservative, let's use $280

What's the Cost of Unnecessary Exposure?

$1.25 million/year

Annual Total Savings from Improved Monitoring

Unnecessary Closures:	$6 million
Unnecessary Exposures:	$1 million
Total Costs	$7 million

Does not include BEACH POSTINGS!
NRDC reports average of 2,456/year
LA and OC (1999-2002)

On-Going Research: What Else Do We Need to Know

1) What's the true cost/illness? (Dwight and Fernandez, forthcoming)
2) What's the increased public health burden from swimming in ocean waters (in SoCal)? (Pendleton and Boehm/Stanford labs)
3) Do beach postings and warnings reduce swimming exposures? (Pendleton and Boehm/Stanford labs)
   Can the public make informed decisions about water quality? (Pendleton and Turbow)

Footnote #1:

Method 1: Visits Increase By Daily Average Attendance

(Average visits/day) x (proportion of visitors that swim) x (additional beach days) x ($$/day) = change in recreational value

Method 2: Proportional Increase in Beach Visits

Current total value of water related activities x (additional beach days/ total beach days) = change in recreational value

Questions and Answers

Q: I think you are underestimating because you are not showing that although there were less acute gastrointestinal illnesses, people were more likely to stay home from work and more likely to go to a physician's office. So, I think you presented an estimate of what the true costs really are.

Linwood Pendleton

It is a lower bound. I try to do that with every step, and for the very same reason we chose that. But, you are right.

Comment: Yes, I think it is more than that. But I think you did a good study.

Q (Carl Berg, Hanalei Watershed Hui): A lot of the viruses and bacteria become aerosole-borne at the beaches. So, just by going to the beach you still have an exposure, even if you do not go into the water. I think you underestimate the effect of people going to the beach but not going swimming. Your 28 percent might not be a good factor because you have an exposure rate of perhaps 50 or 60 percent of the people.

Linwood Pendleton

I was looking at the beach closure. This would require that I know how the beach closures affected those who had gone to the beach. I could do that too. But, I can't do that with the data I have, but we could do that if we went to a beach and looked to see who was exposed. But when I'm using the attendance figures, it's everyone who came to the pier, even those who went bike riding and rollerblading. So, you are right. This is the lower bound if you add onto that the incidences of disease. I also looked only at gastroenteritis, so it is a lower-bound there. I did not look at eye or ear ailments or acute fever incidences. This is just a lower-bound. So, we may want to add to that a respiratory ailments from people sitting by the edge of the beach.

Q (Shawn Ultican, Kitsap County Health District): If you are looking at the costs of a closure, whether it is the cost of lost recreation or cost of going to a doctor, is that really a cost or is that money just being displaced? For example, if I want to go to Beach A, and Beach A is closed, maybe I just take my money and go to Beach B. It might be a half hour further away, but if I really want to go to the beach that day, I will still go if there is an opportunity available in another location. And, are the costs of going to the doctor just the costs of moving from me doing my job in producing whatever I produce in doing my job and transferring that to the healthcare system where I'm paying somebody else to do their job? Does that make sense?

Linwood Pendleton

The lost recreational values that are a cost to the economy is how much less happy you are or how much money you spend that you didn't need to spend to drive to the beach. So, those recreational values look at the value that people place on a beach recreation visit beyond whatever they paid. Expenditures, on the other hand, refer to when you take the money that you were going to spend on Doheny Beach, you go to San Clemente and spend you money there. In that case it's a transfer, unless you are in San Clemente. If you are in San Clemente and you are trying to figure out whether we want to go to this more expensive monitoring system, then it's a cost to San Clemente because you lose those expenditures. It is not a cost to the overall economy. Medical expenses are real costs. When you are using a doctor's time that could be spent on another patient, productivity is lost. For example, if you look at the gross state product of Florida, it will go up because you have all these building projects now. Everytime they build a new house that got knocked down by a hurricane that will look like an increase in the economy. Its not like that with medical costs. What we are talking about here are real costs to society because we are using resources to run medical tests and staffing the doctors' offices, and we are losing real productivity when you don't go to work. So, that is what is reflected in those medical costs. The willingness to pay is what in litigation they call psychological damages, which is when people are relatively unhappy because they got sick, and that represents an economic cost too. So, of those three, two are unambiguously costs to the economy, and the third one, expenditures, depends on the perspective from which you are viewing this.

Communication: Increasing Public Awareness about Beaches

Harry Simmons
American Shore and Beach Preservation Association

Biosketch

Harry Simmons is President of American Shore & Beach Preservation Association. Mr. Simmons also serves in his 5th year as Mayor of the Town of Caswell Beach, North Carolina and is executive director of North Carolina Shore & Beach Preservation Association. Mayor Simmons serves on the boards of directors of the North Carolina League of Municipalities, the North Carolina Coastal Communities Coalition and as a Coastal Cities member of North Carolina's Coastal Resources Advisory Council. He has recently formed Simmons Coastal, a broad-based coastal issues consulting firm currently seeking additional clients from among businesses, governments and individuals along America's coast. Find him on the web at SimmonsCoastal.com. A North Carolina native, Mayor Simmons earned his BS in Business Administration from the Kenan-Flagler Business School at the University of North Carolina in Chapel Hill.

Abstract

The American Shore and Beach Preservation Association has been successful linking healthy beaches and the economic benefits those beaches provide to both the local and national economies. This presentation will provide conferees with information on how to more successfully link healthy beaches and productive economies.

Over 53% of the nation's population lives in coastal counties. By 2015, the population of coastal counties is expected to reach 165 million residents, with an average of 3,600 people moving to coastal regions daily. Those that do not live in coastal regions often spend their vacations there. Beaches are American's top tourist destination. For instance, Miami Beach is visited by more people than all the National Parks combined.

Better beaches lead to increased travel and tourism. The benefits begin at the local level and expand outward. For example, tourists visiting healthy beaches spend money at local businesses, which in turn expand and invest in new employees and capital. Those employees, and the firms that benefit from capital improvements, then spend their money buying goods and services. According to a recent federal study, only 35 percent of a shore protection project's benefits accrue locally, while 65 percent accrue to people who reside elsewhere.

When a community's beaches must be closed for even a day, everyone loses tax revenue. We need to work together to publicize that message to the public and to elected officials so states and communities do more to assure the highest standards of beach water quality.

The Economic Engine that Drives Coastal America: Healthy Beaches

Harry Simmons, President
American Shore and Beach Preservation Association

for US EPA National Beaches Conference

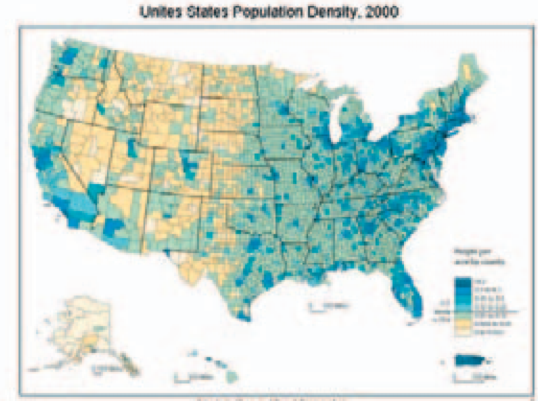
The Economic Facts

- **53% of Americans live in Coastal Counties** (2000 census) (number derived from dividing coastal population (148.3 million) by US population (281.4 million) and multiplying by 100 to get the percentage of Coastal population in relation the US population as a whole (52.7%))
  - By 2015 the population of the coastal counties is expected to be 165 million (Testimony of Admiral James D. Watkins, U.S. Navy (Retired), Chairman, U.S. Commission on Ocean Policy – PART II [illegible])
  - That's an average of 3600 people moving to coastal regions **daily** (Testimony of Admiral James D. Watkins, U.S. Navy (Retired), Chairman, U.S. Commission on Ocean Policy – PART II [illegible])
  - These counties produce 32 percent of America's gross domestic product [illegible]
- **180 million Americans make 2 billion annual visits to ocean, gulf and inland beaches** [illegible]
  - This is twice the number of visits to all properties of the National Park Service, Bureau of Land Management, and all state parks and recreational areas COMBINED (National Association of State Park Directors, 2000)
  - Coastal states earn 85 percent of all U.S. tourism revenues (Leeworthy) (World Almanac 2001)

Population Density

- The national population density is 79 people per square mile compared to the near shore area where density is 230 people per square mile. (Colgan, Charles S. 2003. "The Changing Ocean and Coastal Economy of the United States." A briefing paper for conference participants at the National Governor's Center for Best Practices Conference, Waves of Change: Examining the Role of States in Emerging Ocean Policy. October 22, 2003. 11pp.)
- From 1970-2000 the national population density increased by 22 people per square mile while the near shore area increased by 43 people per square mile. (Colgan, Charles S. 2003. "The Changing Ocean and Coastal Economy of the United States." A briefing paper for conference participants at the National Governor's Center for Best Practices Conference, Waves of Change: Examining the Role of States in Emerging Ocean Policy. October 22, 2003. figure 3 page 10)

Unites States Population Density, 2000



The Coastal Economy

- Over 75% of all U.S. domestic economic activity takes place in the coastal states (An Ocean Blueprint for the 21st Century. Final Report of the US Commission on Ocean Policy. September 2004. Appendix C pp 10)
- All of the economic tiers of the Coast, from the near shore area to the total coastal states, grew faster than the U.S. economy over the past decade:
  - **Establishments**
  - **Employment**
  - **Wages**
  - **Output (Share of State Gross Product)**

(An Ocean Blueprint for the 21st Century. Final Report of the US Commission on Ocean Policy. September 2004. Appendix C pp 10)

Domestic Tourism

- **Beaches are Americas Number One tourist destination**. (Christine Todd Whitman, Former Administrator of the U.S. Environmental Protection Agency [illegible] OpenDocument)
- **Nearly 110 million U.S. Households traveled over 50 miles to go to a beach last year.** ([illegible] Press release from the National Tour Association about the TIA Domestic Travel Online database (database is by subscription only))
- **41% of U.S. households visiting the beach include children under the age of 18** ([illegible] Press release from the National Tour Association about the TIA Domestic Travel Online database (database is by subscription only))

Foreign Tourism

- More than **90 percent** of foreign visitors to the United States make a visit to our coast (Houston, James R., 2002. *The Economic Value of Beaches – A 2002 Update*. U.S. Army Engineer Research and Development Center.)
    - **The annual $2.4 billion revenue from foreign tourists at Miami Beach is about 50 times the total $52 million cost of the Miami Beach beach nourishment project that has lasted over 20 years (Houston, 1996).** (Houston, James R., 2002. *The Economic Value of Beaches – A 2002 Update*. U.S. Army Engineer Research and Development Center.)
- In a recent year, 45.5 million international visitors came to the United States and spent $60 billion dollars (http://www.yoto98.noaa.gov/yoto/meeting/tour_rec_316.html)

American Shore and Beach Preservation Association

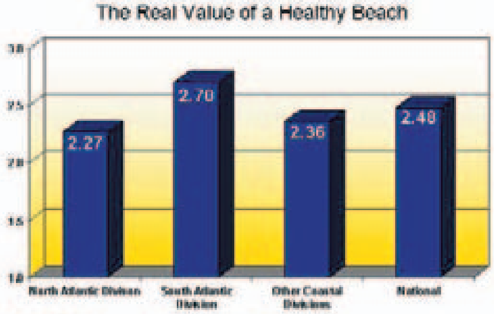
Hierarchy of Coastal Benefits

- Benefits begin at the local level and expand outward:
    - **Beach travelers are more likely to travel to their destination by plane and rent a car when they arrive**
    - **Tourists visiting beaches spend money at local businesses**
    - **These local businesses expand and invest in new employees and capital**
    - **The employees and the firms that benefit from the capital improvements then spend money buying goods and services.**
- 65% of shore protection project benefits accrue to people who reside somewhere other than the beach area. (USACE economists) (USACOE, Institute for Water Resources, Shoreline Protection and Beach Erosion Control Study http://www.iwr.usace.army.mil/iwr/services/pdcpnshoreline.htm)

American Shore and Beach Preservation Association

Benefits to Costs Ratio:

The Real Value of a Healthy Beach



Data compiled by Harry Stoudy Consulting. (Harry Stoudy 2004, USACOE civilian (ret.))

American Shore and Beach Preservation Association

But What About Water Quality and Beaches?

When a community's beach must be closed even for a day, everyone **loses** recreation, environment, and tax revenues.

American Shore and Beach Preservation Association

We all need to work together to publicize the water quality connection clearly to the public and to elected officials,
so communities will do more to assure the highest standards of beach water quality

ASBPA stands committed to aid in that effort any way we can

American Shore and Beach Preservation Association

For More Information, Contact

ASBPA

c/o Marlowe & Company
1667 K Street, NW Suite 480
Washington, DC 20006
202-775-1796
beaches@asbpa.org
or contact me directly at
president@asbpa.org

American Shore and Beach Preservation Association

Questions and Answers

No questions.

City of Encinitas Perspective on Beach Postings

Katherine Weldon
City of Encinitas, Clean Water Program

Biosketch

Katherine Weldon has over 12 years of experience in Water Quality Management Programs. Most of her experience has been in role of program manager for the Recreational Ocean Water Quality Coordinator for the County of San Diego and most recently as the Stormwater Program Manager for the City of Encinitas. Ms. Weldon has been active in the field of stormwater monitoring since 1993 when the County first began testing storm drains. Kathy developed a voluntary ocean-monitoring program with the POTWs, which became a routine monitoring program for the County of San Diego. She has been involved with the implementation of AB411, which mandated a routine coastal monitoring program for the State of California.

Throughout Ms. Weldon's career she has worked for the public sector. She has developed the City of Encinitas' Stormwater Program from the beginning, which is considered the model by the Baykeepers and the local Regional Water Board. Kathy has created numerous presentations for City Council as well as the local media. She works with each department from public works, engineering, construction and planning. Ms. Weldon's most recent accomplishment is the completion of the Moonlight Beach Urban Runoff Treatment Facility, which cleans the creek of bacteria and viruses prior to being discharged back into the creek.

Abstract

The City of Encinitas, a coastal town located 25 miles north of San Diego with 6.2 miles of beaches, generates an estimated $44,000,000 of revenue annually. Moonlight Beach, the crown jewel, supports 4000 beach users on a summer day, with facilities including volleyball courts, fire rings, snack/rental shops, and lifeguards. Water quality at Moonlight has been historically poor due to Cottonwood Creek, conveying bacteria in urban runoff directly to the beach. Understanding the value of the resource, the City installed an ultraviolet treatment facility on Cottonwood Creek to compliment persistent upstream investigations, killing 99.9% of the bacteria. Nearly $11,000 are spent annually monitoring water quality at Moonlight, above and beyond the required AB411 program. With these Best Management Practices, postings due to sewage and urban runoff have been nearly eliminated.

Yet, Moonlight continues to have postings, often a result of misguided policy not protective of public health. Guidelines such as sampling before 11 am or the inability of weekend staff to un-post beaches has kept Moonlight posted when bacteria samples indicate acceptable water quality. Three cases of postings not protective of public health and their fiscal impacts will be discussed.

Samples of seagull feces have been analyzed for bacteria indicators, data will be presented. Understanding contributions from this source of bacteria leads the City to question how often beaches are posted due to natural sources. Is the enterococcus standard often exceeded because of natural sources, resulting in incorrect perceptions of water quality? A study supporting this hypothesis will be presented.

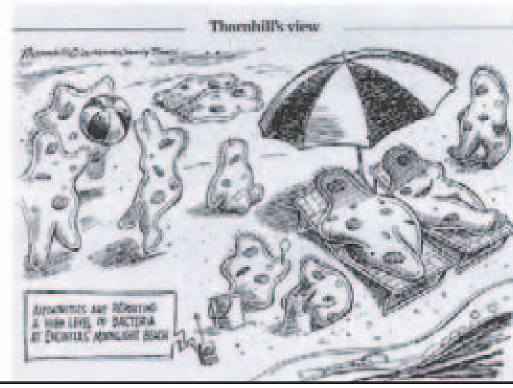
City of Encinitas

A Local Cities Perspective on Beach Postings

by

Kathy Weldon & Paul Hartman

Public Perception is Everything



Key Points

- Overlapping jurisdiction and regulations
- Resampling & Geometric mean
- Nexus to public health
- Economic Impact
- Local Stormwater programs can provide a timely service to reopen beaches.

City of Encinitas and Cottonwood Creek Watershed

- Encinitas Fun Facts
- 6.2 miles of beach
- Population 60,000+

- Cottonwood Creek
- 3 sq. mi (2,000 acres)
- 95% heavily urbanized

Protecting Public Health

- Educating the public & business owners
- Issued 100's of Notices of Violation
- Extreme Water Testing and Watershed Analysis
- Televised and tested sewer lines to eliminate sewage as a potential source
- Installed a Ultraviolet Treatment Facility to treat Urban Runoff
- Daylighted Cottonwood Creek
- Periodic relocation of homeless encampments
- Removal of kelp on a weekly basis
- Extreme water testing

City of Encinitas NPDES Monitoring Programs

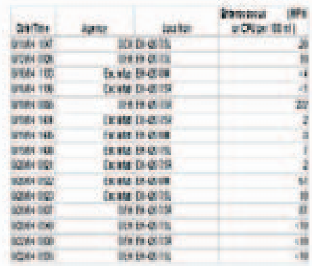
- Dry weather monitoring @ 44 sites
- Leads to investigation and increased sampling
- Coastal & Lagoon Monitoring Program - Paired sampling at stormdrain and mixing zone
- Wet Weather Monitoring Program
- Weekly sampling for the UV Treatment Facility
- Special studies
- Cost for Monitoring $76,000 per year

Numerous Coastal Regulations

- AB411, CA Health & Safety Code
- California Ocean Plan
- California Basin Plan
- Stormwater Coastal Monitoring Program
- TMDL for Bacteria
- EPA Beaches Act

We need a Comprehensive Coastal Management Program

Resampling & Geometric Mean



- Posted on 8/19/04
- Resample collected on 8/19/04 upon notification (~2 PM), results clean
- Resample 8/20/04 (~9:30 am), results clean
- Posting remained due to geometric mean despite multiple days of clean data at multiple locations on beach (75R, 75L, and 0M)

Issues we see…

- Resample collection and acceptance of data, sample times: samples collected upon notification were NOT considered representative and excluded from data set
- Use of Geometric Means to post when analysis allows for detection limit of 10 mpn/100 ml (nearly 30% to a posting with the cleanest of the data!!)

Nexus to Public Health Protection

- Postings always occur 24 hours after an exceedence is collected, depending upon method, may be 72 hours after the initial sample was collected.
- Postings appear to be result of natural, transient sources most of the time.
- In house studies have shown elevated bacteria when creek water flows through heavy wrack line.
- NONE of the postings within the past three years have had a second AB411 Exceedence upon resampling, however, the beach is regularly posted for 3 or more days following a hit.
- There were no reports of illness at Moonlight Beach this past summer (per conversations with lifeguards and camp directors)

Moonlight Beach

- Summer Programs
- YMCA Water Camps
- Surf Schools
- Jr. Lifeguard Programs
- Boys & Girls Clubs, etc.
- Tourist, surfers and regulars

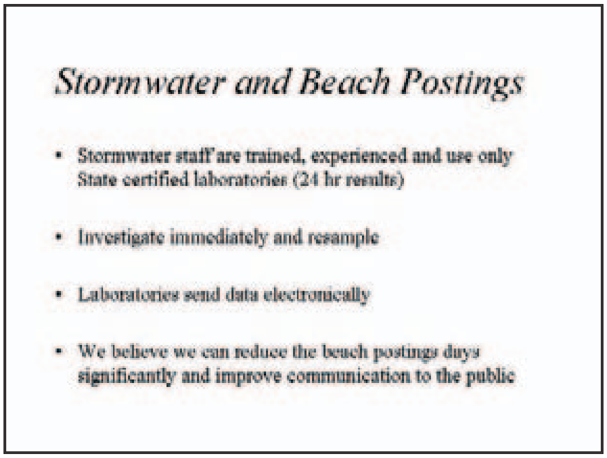
Moonlight Beach Attendance Data

3,300 people per day (June -Aug)

$58,000 daily revenue

2,387,400 - Total Annual Visitors

$41,305,200 - Annual Beach Generated Revenue for Local Businesses


Stormwater and Beach Postings
• Stormwater staff are trained, experienced and use only State certified laboratories (24 hr results)
• Investigate immediately and resample
• Laboratories send data electronically
• We believe we can reduce the beach postings days significantly and improve communication to the public

Questions and Answers

Q (Matt Liebman, US EPA, Region 1): Is there a perception about water quality that keeps people from coming back to the beach well after the beach has been posted or closed?

Kathy Weldon

In 1999 we had 93 days of beach postings. Yes, I believe there was a slow reduction in population, but we have seen it escalating since then and we have been reducing the beach closures every year since then. This doesn't stop families from going to the beach. Parents will still let their kids play in the water. I think it just adds a level of concern in their minds, and it makes them think about next time, asking them selves, "am I going to come back to this beach or go somewhere else?" It does the same thing to the lifeguards. They will ask themselves, "is our beach clean enough and should I let people go into the water?" It's a level of concern that is difficult to document.

Comment (Tim Wade, USEPA): I would suggest a more random sampling and/or a follow up survey prior to concluding that people are not getting sick. I think a lot of the cases we see are mild and may not be reported to the lifeguards.

Q (Carl Berg, Hanalei Watershed Hui): What kind of tests were you using? Was it enterococcus?

Paul Hartel

We used membrane filtration for enterococcus.

Comment (Carl Berg): We are using IDEXX technologies to do that, and with a dilution, you can only measure down to 10. However, if you take three simultaneous samples and they all show a zero , then your detection level is statistically down to one. That would help you with your geometric means quite a bit if you are able to do repeated sampling. This may statistically improve your numbers and bring them down much quicker.

Q (Charles Kovatch): How well does the laser counting estimate the population?

Kathy Weldon

It was close to the lifeguard counts from before.

Q (Charles Kovatch, US EPA): Are any other beaches in California using the lasers?

Kathy Weldon

Not that I know. Our lifeguards stopped collecting data (they were told not to) so we tried to find a way to collect the data without the lifeguards.

Q: How much did the people counters cost?

Kathy Weldon

They cost around $600 per site.